

ONLINE SCIENCE TEACHING AND LEARNING AMONG CHILDREN DURING COVID-19 PANDEMIC

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The paper examines the situation and emerging crisis in the pandemic and the condition of school education with special reference to science education. Continuing the education of students emerged as a major challenge during the unprecedented lockdown. Digital learning is a terrain which was not widely explored by the teachers for classroom teaching. The education sector in India is one important area that has been severely affected by the lockdown and the imposed restrictions. The study was conducted with 500 science teachers from 9 states on various pertinent points including awareness, preparedness mode, methods used teaching, usage of apps, managing-interactions, assignments and assessments during the COVID-19 pandemic.

Keywords: Digital learning, online science teaching and learning, science teachers.

Introduction

Planet Earth has witnessed many epidemics in the past centuries. From the dark ages, we have come such a long way, that we now have ways to combat such deadly diseases. The pandemics also affect the socio-cultural dynamics of the society, even long after they are eradicated. The year 2020 saw the advent of an unprecedented pandemic — COVID-19 caused by a novel coronavirus.

History of pandemics in the world

In the history of the world, there have been many infectious diseases that have claimed the lives of millions of people. The Great Plague was the major epidemic of the bubonic plague in England, which lasted from 1665 to 1666. Another plague, which was caused by the *Yersinia pestis* bacterium, killed an estimated 100,000 people. Tuberculosis (TB) caused by *Mycobacterium tuberculosis* is

responsible for approximately 1 million human deaths every year (World Health Organization 2020a). This disease took a death toll of millions before antibiotic streptomycin was discovered in 1943. Swine Flu Pandemic in the USA in 1976–1977, also commonly called influenza infected about 500 million people with a mortality rate of about 10 per cent.

Currently, all the countries across the world are under the fatal clutches of COVID-19. The first cluster of cases was formally reported in Wuhan City, China, on 31 December 2019.

WHO became aware of 282 confirmed cases across the Asian continent. The cause of the severe acute respiratory syndrome that became known as COVID-19 was a novel coronavirus, SARS-CoV-2. The virus was isolated on 07 January, and its genome was shared on 12 January 2020.

The world transformed in the blink of an eye. The virus spread faster than anticipated. 2.45

million people had been reported dead from the coronavirus COVID-19 outbreak as of 07 August 2020. The number of recorded deaths in India due to coronavirus have been 1,56,212 as of February 20, 2021 (Ministry of Health and Family Welfare, GoI).

COVID 19 pandemic in India

India was also not spared. With its first confirmed case reported in Kerala, in a student returning from Wuhan, the Government of India sprung into action. The Prime Minister of India urged all people to stay at home except those in essential services, calling for 'Janata curfew' on 22 March from 7 AM–9 PM. With the success of this endeavor and the escalating spread of this virus, the PM of the nation declared countrywide lockdown for 21 days with effect from 25 March 2020, in the exercise of the powers under section 6(2)(i) of the Disaster Management Act, 2005.

COVID-19 pandemic and school education in India

Due to the nation-wide lockdown, all educational institutions were closed. All national and state-level examinations were also postponed, keeping in mind the safety of the students. Students were now confined to the safety of their homes. However, despite the best efforts of the government, the people, and the agencies, the virus spread fast. Although the curve was significantly dampened, the number of positive cases kept increasing. The lives of the citizens, could not be put at stake. At this crucial juncture, the lockdown was further extended.

According to the 2020 Global Education Monitoring Report (UNESCO), almost 91 per

cent of students worldwide were out of school during school closures in April 2020. Students were deprived of any regular curricular activity for close to 2 months during the lockdown period. They were also getting restless without social interaction and physical activity (games and sports). Keeping them occupied at home posed a challenge for the parents. The parents working from home already had a lot on their shoulders with businesses downsizing, handling child development and addressing their educational needs became a big issue.

All the institutions switched to online classes under the directives of MHRD. The transition from a conventional classroom to a digital one was an uphill battle for all the stakeholders — the administration, the teachers, the students, and the parents. The digital infrastructure was not in place to completely support teaching-learning. Not all institutions were equipped for this transformation on such short notice. The majority of teachers' preparedness in these digital mediums was limited compared to the need of the hour (Sinha, 2020a; Sinha, 2020b).

Importance of Science

Science is one of the most important subjects. It is a universal fact that it enables the students to develop problem-solving and critical thinking skills. Science education enables students to generate ideas, intelligently take decisions, analyse events and phenomenon, and derive conclusions. The implications of these skills is lifelong. Science needs to be taught and learned as a sport for the brain.

The nature of Science is to investigate through experiences and then logically infer and

explain the data collected. In a conventional classroom before the COVID-19 pandemic,

science teaching was supplemented by experiments, observations, hands-on activities. Teaching science pedagogy involves activities in groups, discussions with classmates and teachers, surveys, organization and data analysis. Display of models and project work through exhibitions, etc., in schools and neighborhoods, were an important component of pedagogy (NCF, 2005). National Curriculum Framework (NCF) 2005 proposed activity-based teaching as a paradigm shift for science learning. Laboratories and outdoor activities are inseparable from science teaching and learning. Due to the current pandemic, all such activities came to a halt. With students and teachers confined in their homes, it was difficult to perform activities and experiments.

Most school teaching in COVID-19 times is being carried out online or via other modes of distance learning. The teachers resorted to various digital platforms to facilitate the process of teaching-learning. Classes were being conducted on Zoom, Google Meet, and WebX. WhatsApp and Telegram messages in a group became the new digital noticeboard. Assignments were given and submitted on google forms or drive. Assessment sheets were circulated as images on various platforms or as emails to the parents. Feedback was not instantaneous as rapid switch-over did not leave any room for teachers to evaluate while getting accustomed to teaching through digital mediums (Sinha, 2020a; Sinha, 2020b).

Subjects with less dependency on the laboratories and experimentations were quick to adapt to the situations. Although subjects

like law and languages lost the flavor of their regular activities like moot courts, debates, discussions, and brainstorming sessions, they still had the upper hand over subjects like Science that involve demonstration and experimentation.

The author conducted a quick survey to determine how science teaching is being carried out in schools in the lockdown period. A total number of 500 science teachers from Delhi, Haryana, Chandigarh, Chhattisgarh, Bihar, Tamil Nadu, Madhya Pradesh, and Uttar Pradesh participated in the survey.

Results and Discussion

Based on responses received, the following picture about science teaching in these States/UTs emerged :

1. Use of digital mediums/platforms for teaching

100 per cent of the participating teachers (both government and private) carried out Science teaching using various digital mediums.

2. Ease of adaptation of digital mediums/platforms for teaching

Even though the implementation of online teaching was done hurriedly with little time to plan, only 1/3rd of the participant teachers could adapt to the online mode of teaching science effortlessly.

3. Types of digital platforms used

While some of the teachers relied on free digital platforms to conduct online classes, viz., Google Meet, Zoom, and Webex, most of them (60%) also used other mediums that were a part of their learning management systems (Fig. 1).

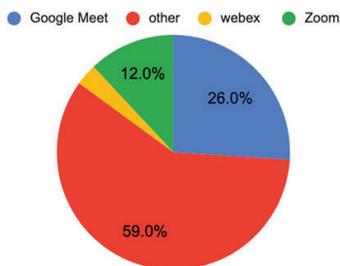


Fig. 1. Type of digital platform used in conducting online classes

4. Mode of digital communication used.

To communicate with students and parents, science teachers heavily relied on WhatsApp audio, text, and video messages. Communication through the emails was the least used method. Teachers in private schools used already existing Learning Management Systems for communication. In remote places, with network-data issues, teachers used the phone call as the primary communication mode (Fig. 2).

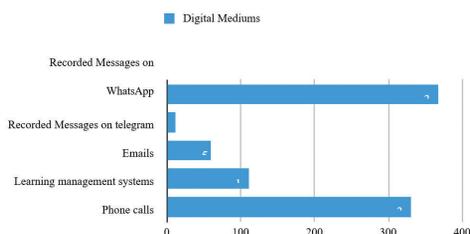


Fig. 2. Use of various digital mediums

The digital mediums that became inevitable due to the pandemic conditions were seldom used before by the whopping majority of science teachers.

5. Preparedness for using digital mediums

The teaching fraternity was caught unawares by the magnitude of the pandemic and

the duration of lockdown. 368 out of the 500 participating teachers taught themselves to use digital mediums and devices for conducting online classes by looking at various videos online. Teachers, mainly from private schools, had multiple training programmes to aid them in this transformation.

6. Time spent on preparation of lessons

Since this paradigm shift from face-to-face to online class completely was unprecedented, teachers had to devote double the time than usual to prepare for their online classes.

7. Methods of demonstrating science experiments

80 per cent of the respondents relied on YouTube videos for demonstrating science experiments.

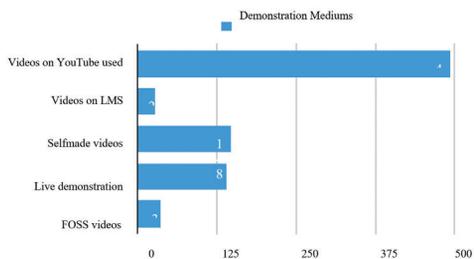


Fig. 3. Methods used in demonstrating Science

Science experiments were done live on the online streams with whatever means were available to them while using YouTube videos as a reference. 148 teachers out of 500 participants took the initiative to record their videos and sent them to students for reference (Fig. 3).

8. Use of advanced science-related apps

Teachers in Chandigarh and Delhi used augmented reality apps to supplement their science teaching. 25 per cent of the participating teachers relied on online simulation of laboratory experiments.

Teaching with the help of new software that is specifically made for science topics was an unknown phenomenon. None of the teachers mentioned any specific software for this purpose.

Teachers also mentioned that to supplement their teaching, they accessed various platforms/apps viz., Coggle (Mind maps and flow charts), Padlet, PhET (interactive simulations), Olabs, Edpuzzle (interactive video lessons), Nearpod (interactive lesson), and pixel lab.

9. Responding to the queries and doubts

To address students' queries, the participating teachers used WhatsApp and telegrams texts, audio notes, and short video clips. Email was the least used medium. A lot of them resolved student's doubts during the online class itself. Few teachers conducted separate sessions for answering students' problems, as shown in Fig. 4.

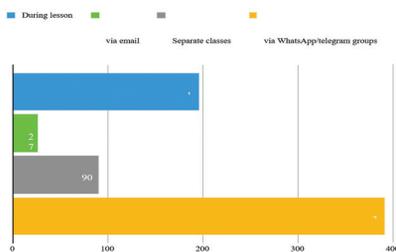


Fig. 4. Dealing with queries and doubts of students

10. Mode of collecting assignments

Many teachers, especially in remote areas, used WhatsApp and telegram to send and receive student's assignments. Participants of private schools relied on their Learning Management Systems (LMS) wherever available, while some resorted to using Google Drive, as depicted in Fig. 5.

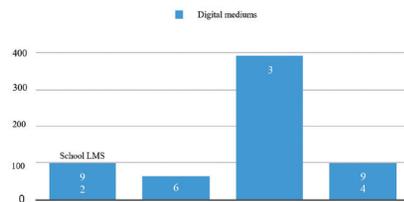


Fig. 5. Mode of collecting assignments

11. Assessment

Assessment is an important part of teaching-learning. Assignments were given to the student from time to time. It will be difficult to assess the students during online lessons as the teachers themselves face issues in digital classrooms. Assessing students digitally is a challenge as compared to that in conventional classrooms. For the collection/submission of assignments, various mediums were used. Most of them circulated and collected questions and exercises through Whatsapp/Telegram groups. Assessment questions, quizzes, and assignments were given and collected through School Learning Management Systems (LMS) by a considerable number of teachers (Fig. 6). Most of the teachers graded the students on the assignments that were submitted.

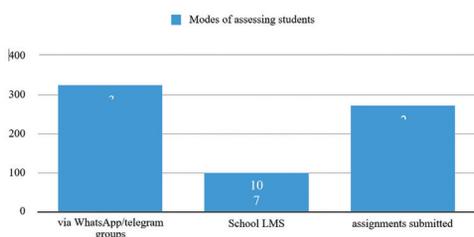


Fig. 6. Modes of assessing student

12. Online vs. Conventional classroom teaching

Surprisingly, 6 per cent of teacher participants felt that online teaching of Science was a better experience than classroom teaching.



Fig. 7. Online teaching vs. conventional classroom teaching

13. Awareness about existing digital initiatives by the government

The GOI had started the Swayam Prabha Channel to promote digital initiatives. SWAYAM Prabha is an initiative to provide 32 High-Quality Educational Channels through DTH (Direct to Home) across the length and breadth of the country on a 24X7 basis. It has curriculum-based course content covering diverse disciplines. The channels cover both school education (classes I to XII) and higher

education. 30 per cent of the participants were not aware of this initiative. 60 per cent viewed the programmes broadcasted and found them useful, while the remaining 10 per cent did not use them as a resource.

The alternative academic calendar prepared by NCERT was followed by the majority of the participants (72%).

Issues while teaching Science during times of COVID-19

Without thorough training, using multiple digital mediums posed a big challenge for teachers. Several issues were shared by the teachers. In the absence of face-to-face peer interaction, at times, teachers found themselves at their wit's end. They could also not mentor each other since all their time was consumed in preparing for their online classes. The teachers struggling with their devices and digital mediums resorted to using their personal devices for conducting classes, the devices which might not have been updated. They spent money personally to buy updated devices for these classes. Teachers also faced difficulty in assessing students online. While recording videos for e-content, teachers struggled with various software to edit, add text, screen record and mix images. Teachers who were able to adapt to this online teaching mode faced an issue dealing with more than 60 students at a time in a single online class. To add to their woes, the parents constantly monitored and gave feedback, which made their work all the more difficult. Many network issues cropped up, which interrupted the smooth conduct of classes. Meanwhile, no digital devices at the disposal of many students were also a cause of the interruption. The usual interaction

which takes place face-to-face was missing in a virtual classroom, which also led to students being inattentive. The increase in screen time of students was a cause of concern for everyone.

The majority of teachers learnt these skills online with the limited resources at their disposal. They felt that they need to be trained thoroughly in developing e-content and skills associated with them.

Moreover, giving lessons online also needs practice and confidence. The non-availability of digital platforms in regional languages put them on a back-foot.

Pandemic amplified educational inequities

While efforts were made in every area so that learning can go on, a huge chunk of students from the deprived and marginalised section of the societies missed these opportunities.

1. Differently-abled children either missed or were not able to access the popular mediums.
2. Economically weaker sections were doubly hit. They lost their livelihoods. Sustaining every day was a problem. Adding to their woes, procuring devices and data networks for children was beyond their means.
3. The children of migrant workers missed the online learning opportunities as they migrated across various cities to their native places.
4. It brought forth diverse affective/emotional responses to the lives of the stakeholders.
5. The importance and dire need for family and peer support to provide safe and supportive learning spaces were felt deeply.

Where do we go from here?

COVID-19 is here to stay longer than we expected. Each adversity has its upside, though. There is no way to divorce our response to this pandemic from this realization. Reopening of school shortly is still doubtful. Online learning which emerged as a stop-gap arrangement, can no longer be dismissed. Teachers need to explore ways and come to terms with this reality. The sooner, the better.

Based on the findings of the study, the following solutions are suggested for the future of classroom teaching in Science:

1. After the reopening of schools, future science classrooms may be a blended one — digital and conventional.
2. The teachers will have to integrate Information and Communication Technology (ICT) regularly in their classrooms.
3. Teachers need to be periodically trained to upgrade their digital skills.
4. Efficient and cost-effective learning management systems need to be in place in all institutions.
5. Formulating methods to facilitate online assessment on a large scale should be made a priority.
6. Awareness and usage of software specifically made for Science should be

a part of Teacher training, both pre-service and in-service.

7. During internships, the pupil-teachers must conduct classes in blended mode.
8. Availability of cost-effective digital platforms in regional languages should be a priority.
9. The hurried stop-gap responses now need to be thoughtfully built into cost-effective, robust technology solutions that can be scaled up.
10. The rapid advent of COVID-19 triggered the pervasive use of online learning. We have catapulted five years ahead of our

present expectations for the usage of technology. The momentum need to be carried forward.

Scientifically and technologically literate citizens would contribute better to understand and effectively deal with the pandemic at multiple levels. As of date, the schools have started reopening with limited attendance, opting for both offline and online modes. The lockdown period has allowed the teachers to bring out their creative talent, be patient while using technology, and better understand the dynamics of continuous change in teaching-learning.

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