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Impact of the COVID-19 pandemic on Physics teaching in India

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Abstract. The closure of academic institutions due to the Covid-19 pandemic has compelled formal education in India to move online. The impact of this transition has been very uneven, given the significant digital divide between rural and urban India, and the unequal distribution of digital resources in different institutions. At the individual level, there is significant variability in access to resources, depending on a number of socioeconomic factors, including gender. Institutional support to the academic community at this critical time has been inadequate, with long-term effects on the teaching of physics and other subjects requiring laboratory instruction. Educational institutions also provide safe and enabling learning spaces, especially for women students and their work/study related dynamics could be seriously impacted due to scarcity of resources such as devices, data, and time. This paper reports on efforts made towards understanding some of the above challenges in the critical time of COVID pandemic and ways to mitigate them to some extent.

INTRODUCTION

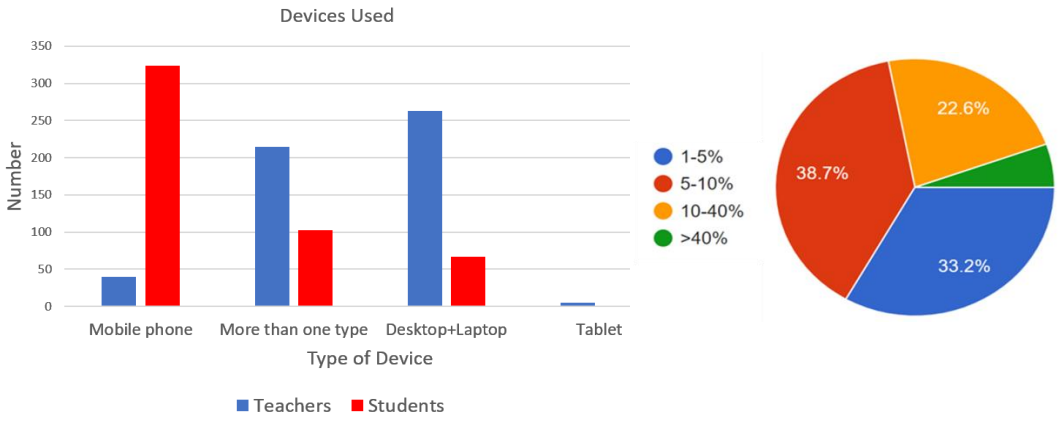
From March 2020 onwards education in India has of necessity moved online. Given the diversity of the country and the uneven access to digital infrastructure, the impact of online transition has been uneven. There is a significant digital divide between rural and urban India which denies access to digital education to a large sector of families in rural sectors. Even within these sectors, there is differential access that depends upon a number of socioeconomic factors, including gender. This can have serious consequences such as early dropouts, change of careers, career breaks etc.

The pandemic has also impacted the institutional support to the academic community (teachers, teacher educators, researchers, and institutions) and an inadequate support has led to long-term effects on the teaching of physics and other subjects requiring laboratory instruction. Educational institutes are seen as hubs where students feel a sense of belong and safety, many stakeholders especially for women students and teachers, the institutes are enabling learning spaces. Away from this, many a times women students and teachers are often burdened with increased familial responsibilities, constrained workspaces at home, and reduced and uneven access to scarce resources such as devices or data. Understanding challenges experienced by the academic stakeholders at this critical juncture of rapid switch to online mode is paramount, as well as how some of these challenges were mitigating in parts in an important knowledge. This paper reports three national initiatives which explore this very issue. Discussion Forum for Online Teaching (DFOT) was set up to address the need of teachers to find appropriate resources and to seek solutions. The National initiatives of “Vigyan Pratibha” and “Vigyan Vidushi” reached out to larger teaching- learning communities from school to MSc levels online in the pandemic time.

DISCUSSION FORUM FOR ONLINE TEACHING (DFOT) SURVEY

The Discussion Forum for Online DFOT [1] was initiated in mid-2020 to address the uneven transition to online teaching in India. DFOT's purpose was to help teachers to adapt to the new mode through sharing resources, discussions, and training sessions. Given the diversity in India - geographical, social, regional and economic – it was evident from the start that the problems faced by teachers was layered. Some problems were pan-Indian (in fact, global) and some were very specific to gender/region and economic status. Regular panel discussions, with experts drawn from all fields and all over the country, were conducted with the dual aim of understanding the problems with online teaching and sharing solutions with fellow teachers. Additionally, a pan-Indian survey was conducted to understand the problems in a better manner. Both the panel discussions and the survey indicated that with very little structural support, teachers and students had to invest personal finances in obtaining appropriate resources for online teaching. When the resources such as space and money to spare were scarce, it was usually the women who had to face the brunt.

The DFOT survey indicated a large digital divide among teachers and students, and between them. Similarly, access to uninterrupted internet data was a problem for many. While the former was predominantly due to economic status of the family, the later had a geographical component to it. Figure 1 shows the survey results for devices used and the percentage of students who were disconnected during a class.



(a) (b)

FIGURE 1. (a) Types of devices used and their frequency b) Proportion of students getting disconnected during a class

Significant responses to DFOT, through both the panel discussions and the survey, are that;

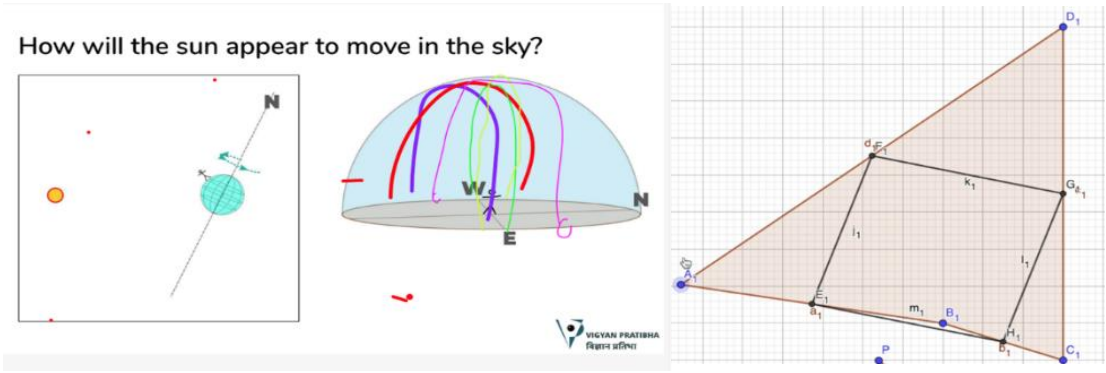
1. Although a large number of students log-in to online classes, nearly 40% get disconnected in between due to lack of proper internet signals.
2. Most teachers use laptops for teaching, most students are attending classes on (shared) mobile smartphones.
3. When mobile phones are shared in a household, girls are at a disadvantage (in terms of access).
4. Household work was another area where women shouldered a larger burden than men.
5. The anonymity provided by online classes have allowed shy students, usually female, to interact more.
6. Conduct of laboratory courses continues to be a problem in Physics curricula. Initiatives such as virtual labs, sending low-cost equipment to the students' homes, virtual-labs, providing students the experimental data to analyse have been taken up by the physics teachers. [2]

The need for pan-Indian initiatives to hand-hold girl students through and after the pandemic was evident.

NATIONAL INITIATIVE OF "VIGYAN PRATIBHA" FOR SCHOOL SCIENCE

"Vigyan Pratibha" is a Department of Atomic Energy, Government of India funded student nurture program being conducted under the academic leadership of Homi Bhabha Centre for Science Education (HBCSE), TIFR, It is aimed at enhancing grade 8th, 9th and 10th students' scientific and mathematical proficiencies through teacher capacity building [3,4]. Since March 2020, pandemic and school closures halted Vigyan Pratibha's students and teachers camps in academic premises when Vigyan Pratibha launched online pedagogy discussion sessions (VPDS) activity to continue interacting with science and mathematics teachers.

The VPDS sessions engaged nationwide schoolteachers in pedagogic discussions of learning units (LU)- an expert-developed resource covering key concepts of science and mathematics developed as a part of the program. Additionally, teachers were introduced to simulation-based STEM experimentation, educational software such as GeoGebra and Mathigon, and makerspace activities (Do it yourself styled) for continuous exploration of scientific phenomenon for student- teacher communities. These activities were discussed considering limited (to no access) to school laboratories and provided alternate avenues to explore physical phenomenon on a simulated platform. The VPDS activity included 70+ sessions in which 250+ teachers (cumulatively) participated. Nationwide teachers channelled their pedagogic discussions on various topics with their distant colleagues through the VPDS online platform and also expressed a sense of support from online community in such difficult times. Many teachers tried the learning units and workshop activities with student groups in online mode after the VPDS session.



(a) (b)

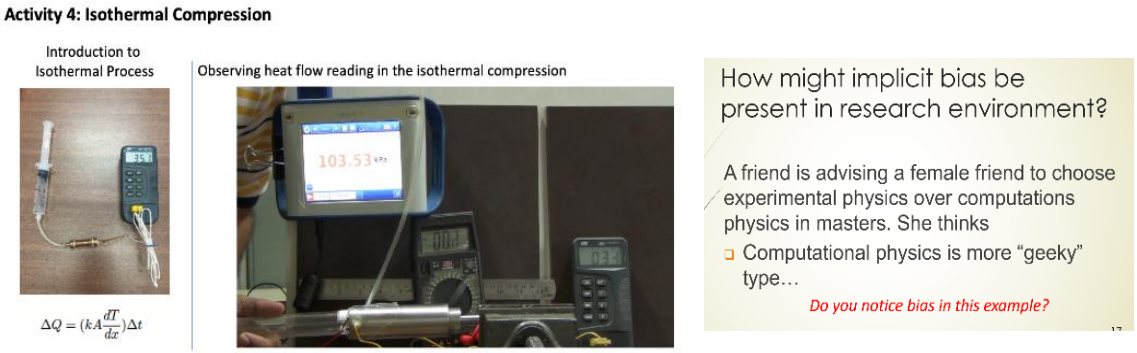
FIGURE 2. (a) A still from "Shadows" learning unit in Vigyan Pratibha. Teachers explore the direction in which Sun will appear to move when seen from the earth's surface standing at a given position using a multiuser board. b) A still from the "Midpoint Quadrilateral" learning unit session where teachers explored GeoGebra platform to draw and study properties of quadrilaterals.

VIGYAN VIDUSHI

Vigyan Vidushi (meaning "a learned women scientist" in Indic language) is a national level advanced summer school in Physics for women students pursuing their first year M.Sc. course. The summer school was jointly organised by TIFR Main campus and HBCSE-TIFR. The Vigyan Vidushi program objectives were a) to offer exposure and training to students in advanced physics areas with an emphasis on problem solving and core concepts' understanding b) provide timely career guidance on opportunities for careers in physics research (globally), and through a group of female physicists, c) expose students to successful women scientists as role models. Additionally, the summer school aimed to provide a sense of challenges in this area and help students to prepare for those challenges through a series of workshops and interactions during the summer school.

The summer school originally designed as an in-person program, due to prevailing pandemic conditions was conducted in virtual mode. The first VV summer school organized in July 2020, and second in June 2021 with ~ 50 students from all across India participating fully in each school in the live classroom. In addition, ~ 1000 students were offered the opportunity to attend lectures on advanced physics topics via live stream. The school included seven core and topical courses in different areas of physics, special lectures by eminent Indian women scientists, virtual lab tours, sessions on Physics Education Research and career discussion and interactive mentoring sessions.

A mixed gender team of 60 faculty, postdocs, scientific staff, PhD students, and other staff of TIFR main campus and HBCSE participated in different roles. The feedback received from summer school participants indicated that the programme was highly successful, and interactions with pan Indian women physicists during the career discussion session were appreciated by the participants.



(a) (b)

FIGURE 3. (a) A slide from the experimental techniques session in Vigyan Vidushi program. b) A slide from "Imposter syndrome" closed workshop.

CONCLUSION

A somewhat sudden shift of formal education in an online mode during COVID pandemic and closure of educational institutes has raised many questions about stakeholders' preparedness, coping mechanism, access and beneficiaries of online education. Among the few initiatives and support groups for education communities started during the pandemic, DFOT in India was one which provided a forum to discuss and understand problems about (disproportionate) access, and various other challenges about online teaching. DFOT panel discussions helped teachers cope with the sudden shift by sharing tips and experiences for effective online teaching. It also provided a platform for peer-support through its various social media channels. The pan-Indian survey among teachers conducted by DFOT clearly indicated a need for infrastructural and financial support for online teaching and that in the absence of such a support, it was usually the female students who faced the brunt. It also indicated a need for nation-wide initiatives for women students. The other national initiative of Vigyan Pratibha through the online VPDS session continued interactions with limited schoolteachers' community in pandemic, while the Vigyan Vidushi program provided networking and mentoring opportunities for female masters' students in physics discipline at the important juncture of their careers. Both these online initiatives, though operated for a limited group of interested student-teacher community, are important as they display some continued efforts of teaching and learning as well as graduate level mentoring in physics, in India, during pandemic times. The need for such nation-wide initiatives for women students is already highlighted in DFOT survey.

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