



Pedagogical Techniques for Mathematics in Covid Era.

Nidhi Arora Dhingra

Assistant Professor,

Department of Mathematics, Ramjas College,

University of Delhi, Delhi-11007.

Abstract: Mathematics like all other subjects have been taught in traditional classroom settings only till Covid hit in 2020. Covid forced traditional education techniques to be rethought as they were not possible given restrictions due to Covid. It was a big push for online content development like Massive open online courses (MOOC's) and related techniques. In this paper, we discuss pros and cons of these techniques and suggest way going forward in Covid free world.

Technology has been scarcely used in our educational institutions in India due to variety of reasons. Foremost being lack of teacher training, lack of infrastructure and lack of incentive to innovate and use the technology. Teachers rely on traditional classroom techniques year on year for delivering their courses using black board and classrooms. This all changed in Covid and teachers were forced to take online classes.

To start with first hurdle in online classes, we saw distributed hardware infrastructure and cheap software technology costs really come to the fore. Teachers pooled in their own laptops and publicly available software such as Teams, Zoom and Google. Students also used their parent's laptop, mobile phones and participated. This forced restriction made everybody make use of available resources and significantly reduce the hurdle of infrastructure. Of course, it has its shortcomings like patchy telecom and electric network across various parts of country, varied availability of instruments with students, but by and large it worked. To make it success in future, we suggest colleges and schools to create separate fund from its resources to make sure they have hardware and software at cheapest possible rates. Technology companies would be happy to provide these along with packaged software as they will derive most of their revenues from software and packaged subscription fees for long term. Internet cards can be made available by government to students and teachers

like erstwhile ration cards to take care of bandwidth and availability constraint. These internet cards should only work for specific sites and purposes. Again, telecommunication companies would really like opportunity to get customers in this growing market along with tying up a customer for future use. Tools like computer and phone stylus also need to be customised for this. Byju's tab is a great example of device which is tailored for online learning. Something like that coupled with pre-paid internet for a social cause would really help in packaging infrastructure in one shot.

Training of both teachers and students is a big issue. Classrooms were of course taken for granted and prodding of a teacher and available feedback of a teacher was a given. Teachers are also used to delivering lectures in comfort of classroom. Of course, there were tech savvy teachers who were really able to adapt and make learning fun for all skill set students but majority of them struggled. It needs to be made mandatory in our teacher training courses that teachers are equally adept at online methods as they are at offline. Teacher promotions and evaluation criterion should really factor in their ability to be good in both formats. Creating customised online content and tools is first big step for teachers to come up the curve. In mathematics, integrating widely available content and tools through portals similar to Coursera would really help. Teacher's ability to use deep resources available on internet to make studies interesting, ability to allow students to experiment, question would really go a long way. In mathematics especially, there is lot of calculations, modelling and iterations which requires consistent discussions between teacher and students. This really requires teacher to be conversant with online tools such as zoom and communication through that. Software tools such as Mathematica, R, GeoGebra need to be made mandatory such that its easier for everybody to migrate and making step wise learning interesting and useful. Applied learning is the way to go in terms of integration between industry and academia. Various application of mathematics should be highlighted in terms of project work and partnership with variety of industry and fields. Project work really needs to come up and take its prominent place in our learning. We need to make it mandatory that every graduate should learn to apply concepts he or she learns through developing an innovative project be it through an application in actuarial sciences, financial world, or physical sciences.

Last bit is incentives which we will focus on. Government of India pushed for MOOC in a big way with New education policy (NEP) and making MOOC mandatory for all in some form. Swayam is GoI's own Coursera and will go a long way in making its adaptation possible across the country. This will set the tone for incentivising everybody to move towards online teaching. Income tax/GST on education related spends needs to be reduced significantly through tax rebates. IT companies also should be incentivised to work on national scale with key institutions to make it a viable client base. Central government can make a centrally sponsored scheme to popularise and develop this in a big way. All research work should be done using technology. Attending seminars in Covid free world also through web etc should be allowed. Resources should be pooled in on bilateral basis across educational institutions similar to exchange programs we have. India has great

strengths with its large base of teachers in Mathematics and we can really show the world this gift like we have done for Information technology sector. Mathematics is universally understood subject so best suited for international collaboration.

In summary, we really need to integrate technology in our teaching methodologies and mindset for making Mathematics more applied and universally liked. It is a core subject and needs to be technology friendly as an educational medium for schools and colleges both. Technology, training, and incentives are the key. All concerned would need to play their part in ensuring the same.

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