The uneven access to technology among children: Evidence from India

Leena Bhattacharya[1] and Shobhit Kulshreshtha[2]

Paper commissioned by UNESCO, New Delhi

Abstract

In recent years the discourse in education has been around the provision of quality education, and, the use of technology towards this end. While the use of technology in education has increased, the digital divide among certain sub-groups of society has become more pronounced. This paper analyses the nationally representative data from the National Sample Survey Organisation's Survey of Education 2017-18 and provides evidence on the prevalent digital divide in India. We adopt a gendered lens and inspect the different ways in which gender intersects with socio-economic characteristics and how that affects the possession and use of digital devices and internet facilities. The results suggest that although India has reached a near-universal attendance rate in the elementary stages of education, the digital divide in terms of possession and use of digital devices and internet facilities remains quite stark. The children who reside in the rural sector, who hail from families with low monthly per capita consumption expenditure, and girls, possess a lesser number of devices and had lower internet facilities in 2017-18. National Education Policy 2020 acknowledges the existing digital divide in society and paves way for the future of education technology in India. Our discussion highlights the vision of education technology use in India and the recent interventions undertaken by the state governments to increase the use of education technology in India.

[1] Leena Bhattacharya has a PhD from Indira Gandhi Institute of Development Research, Mumbai, India. She is the Project Research Scientist at Edtech Tulna Project with the Indian Institute of Technology, Bombay. She can be reached at bhattacharyaleena@gmail.com

[2] Shobhit Kulshreshtha is a Doctoral Candidate at Tilburg University, the Netherlands.

Contents

List of Tables

List of Figures

The uneven access to technology among children: Evidence from India

1 Introduction

The dominant global discourse in education over the last few decades has been towards ensuring universal access and school enrolment of children. Among the 17 Sustainable Development Goals (SDGs) set by the United Nations in 2015, SDG 4 aims to '*ensure inclusive and equitable quality education and promote lifelong learning opportunities for all'*. Globally, 155 countries guarantee at least nine years of free and compulsory education, and 99 countries have a legal framework that guarantees 12 years of free education[3]. Subsequently, an increase in school enrolment has been observed across the countries[4].

As the countries are increasingly moving towards achieving near-universal goals in enrolment, discussions around quality learning opportunities and the use of technology to enhance learning outcomes are gaining importance. The discussion has been reflected in the major commitments adopted by the global education community. The Incheon Declaration emphasises strengthening the education system by harnessing information and communication technologies, as a commitment to provide lifelong opportunities for learning[5] (UNESCO, 2016).

Of the different forms of education technology that have been gaining pace in the last few years, the use of Artificial Intelligence (AI) in education has been a primary one. AI is regarded as a 'disruptive technology' that can transform the education system and alter the teaching-learning process to a great extent (Government of India, 2020a). It is beyond doubt that the effective use of AI, or education technology in general, can have beneficial effects on learning. However, who receives the benefits and the extent of the benefits hinge upon multiple pre-conditions, including, having a robust infrastructure

[3] https://en.unesco.org/news/what-you-need-know-about-right-education
[4] https://data.worldbank.org/indicator/SE.PRM.ENRR
[5] Incheon Declaration states 'Information and communication technologies (ICTs) must be harnessed to strengthen education systems, knowledge dissemination, information access, quality and effective learning, and more effective service provision.' (pp. 8, UNESCO, 2016)

in place. Without that, while a section of society can reap the benefits of the advancement of technology, the others might be pushed to the fringes and be marginalised even further.

The pace at which technology is used to enhance learning has surged due to the COVID-19 pandemic and subsequent lockdowns, with online schools becoming the only possible alternative for millions of children in school. Online learning has the potential to reach the last mile of students, but, during COVID-19, it has benefitted the 'easiest to reach', comprising of students from wealthy communities or families in wealthy countries (Burns, 2021). Thus, this arrangement surfaced a different form of inequality in the society – the one about heterogeneity in access to technology.

This heterogeneity in access and use of technology has brought forward multiple questions regarding the use of technology in education: Who has access to digital devices and the internet and who does not? What does it mean for society? How can policies address these gaps and reach the last mile of children? These questions taken together will build the understanding of infrastructure-readiness in India and in doing so, will be able to comment on the future of AI in education.

This paper begins with the understanding of the heterogeneity in the pattern of school attendance in India, and subsequently examines the prevalent digital divide among the children of the school-going age. These questions are relevant in the Indian context given the policy focus of the last two decades. The Right of Children to Free and Compulsory Education (RTE) Act of 2009 made elementary education free and compulsory for all children aged 6-14 years in India. Furthermore, the National Education Policy (NEP) 2020 lays emphasis on achieving foundational literacy and numeracy, and on the effective use of technology to improve education (Government of India, 2020a). It discusses the need for the use of AI and technology in education. The policy suggests that the states should adopt and support the scale-up of the use of technologies to improve multiple aspects of education.

The paper uses nationally representative data from the National Sample Survey Organisation's (NSSO) Survey of Education 2017-18 and examines trends in school attendance and the digital divide in the age groups 6-14 years and 15-18 years. It adopts a gendered lens to examine the ways in which gender intersects with other forms of socio-economic identities to determine who has access to digital devices

and the internet, and who does not. The results suggest that although India has reached a near-universal attendance rate in the elementary stages of education, the gap increases as we move to the older age groups. Further, in both the age groups, the digital divide in terms of possession and use of digital devices and the internet facilities remains quite stark. The children who reside in the rural sector, hail from low-resource families, and girls, have low levels of possession of devices and internet facilities. Their ability to use devices and the internet remains quite low. With the given state of access and infrastructure-readiness in India, AI remains a luxury for a large part of society.

The existing digital divide has been recognised by the state governments. Bridging the gap is essential since the present scenario can result in a new form of digital divide 'in the use of data-based knowledge to inform intelligent decision-making' (Hilbert, 2016). States have adopted various strategies in recent years to bridge the digital divide – like providing devices to teachers and students, and procurement of software to enhance learning. We discuss the recent initiatives by the states and its implication for school education. Thus, the study contributes to the discourse on improvement in educational indicators in India (Azam & Saing, 2017; Chatterjee et al., 2018; Das, 2007; Datta Gupta et al., 2018; Shah & Steinberg, 2019) on one hand, and the emerging deliberation on the use of technology in education on the other.

The paper unfolds as follows. Section 2 presents the background of the paper by examining the recent trends in school attendance and by identifying the gaps across gender, state of residence, socio-economic and religious groups. Section 3 draws the broad contour around access and use of digital devices as well as internet facilities by analysing nationally representative data. The vision of education technology as reflected by the policy documents is presented in Section 4. It also discusses the progress made by the Indian states to reach the last mile of learners. The paper concludes in Section 5.

2 Background

The relationship between education and technology is bi-directional – education can help in building a technologically empowered society and technology can help in enhancing learning opportunities

(Government of India, 2020a). AI can be used to ensure equitable and inclusive access to education by reaching the most vulnerable groups of children. Yet, in most of the cases, the children who are at risk of not being in school are also the ones who might not possess devices or the internet to learn. That is, marginalised and disadvantaged groups are more likely to be excluded from schools and AI-powered education (Pedro et al, 2019).

We examine both sides – the heterogeneity in school attendance in the first sub-section and the heterogeneity in possession and use of digital devices and internet facilities in the next section. Together it will aid in our understanding of who are at risk of not being in school and whether the same group of children are at risk of not possessing the required devices and facility to reap the benefits of technology. We also lay our focus on the gender dimension while examining the heterogeneity.

2.1 Heterogeneity in school attendance

The data used in this section is from the 75th round of surveys conducted by the NSSO in the year 2017-18 on the 'Household Social Consumption: Education' (Government of India, 2019). This round covered 8,097 villages and 6,188 urban blocks across India. From every village and urban block, a sample of 8 households was surveyed. In total, 64,519 rural households and 49,238 urban households were covered across states and Union Territories (UTs) in India.

This round collected information on individuals aged 3-35 years in India. The groups that we consider for our analysis are children aged 6-14 years and 15-18 years. The former age group of 6-14 years will involve children who are likely to be attending elementary school – that is, primary and lower-secondary levels. Education at this level is free and compulsory under the RTE Act. The second age group of 15-18 years will cover individuals who are in the secondary and senior-secondary school-going age. Although secondary school is not compulsory, providing free and accessible post-elementary education has been a mandate under the Rashtriya Madhyamik Shiksha Abhiyan (RMSA) scheme of the Government of India. Under this scheme which was launched in 2009, the government had made a

target of '*making all secondary schools conform to prescribed norms, removing gender, socio-economic and disability barriers, providing universal access to secondary level education by 2017*[6]'.

Figure 1 (Table 1) shows the percentage of children who were attending school in 2017-18 by age group, sector of residence, and gender. Overall, 95 percent of the boys and 93 percent of the girls aged 6-14 years were attending school in the age group of 6-14 years. This fell to 68 percent and 66 percent for boys and girls respectively in the age group of 15-18 years. There was a steep fall in the percentage of learners who were attending school soon after the end of the compulsory education age of 14 years, relatively higher for those belonging to the rural sector.

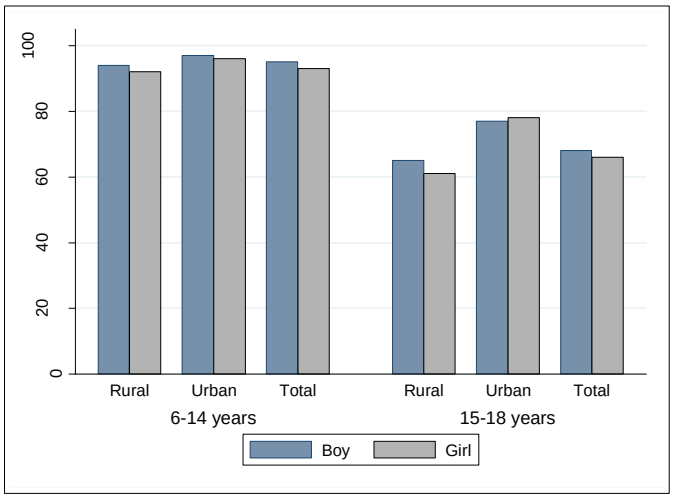

Figure 1: Percentage of children aged 6-14 and 15-18 years who were attending school in 2017-18
Source: NSSO Survey of Education 2017-18

A focus area of the successive education policies has been to bridge the existing gap in school attendance among the social and religious groups. The RTE Act specifically focused on the education of these groups of children. Among the social groups, families belonging to Scheduled Tribe (ST) and Scheduled Caste (SC) communities have been historically disadvantaged. The Framework of Implementation of the RTE Act laid out guidelines to ensure that special attention was devoted to these children to reduce the barriers faced by them in terms of attending, continuing, and completing education (Government of India, 2011).

[6] https://www.education.gov.in/en/rmsa

Figure 2 (Table 2) presents the results by age group, social group composition, and gender. The figure shows that at least a 90 percent attendance was seen consistently in the age group of 6-14 years, but the gap between ST and other social groups persists among both girls and boys. The major gap in school attendance was observed in the age group of 15-18 years. The gendered division becomes apparent as well. In the older age group, there was a 20-percentage point difference between school attendance of boys belonging to ST communities and those from the general social groups. Among girls, the difference is higher at 27 percent. Classification by sector shows that the differences were more prevalent among children in the rural sector, relative to those in the urban sector.

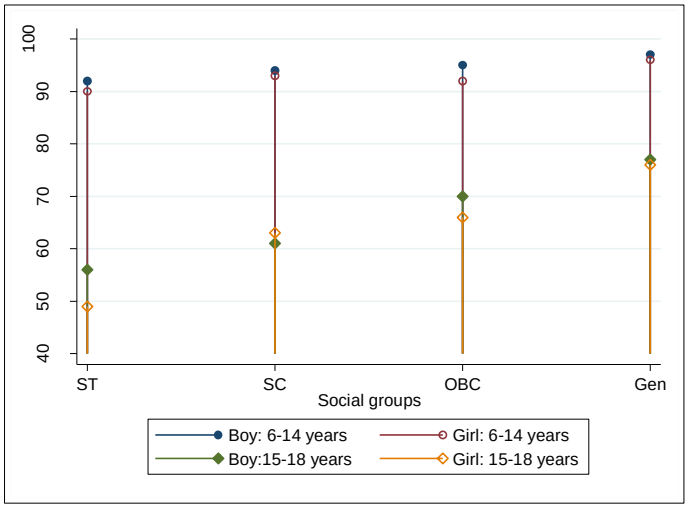

Figure 2: Percentage of children aged 6-14 years and 15-18 years attending school in 2017-18 by social groups
Source: NSSO Survey of Education 2017-18

In India, children from Muslim communities have faced historical disadvantages in terms of completing school (Goel & Husain, 2018; Husain & Chatterjee, 2009). To understand the difference, we classify the households based on their religious groups into Hindus, Muslims, Christians and 'other religious minority groups' or 'Others' comprising of individuals belonging to Sikhism, Buddhism, Jainism and Zoroastrianism. In Figure 3 (Table 3) we see that the differences in school attendance among children from Muslim families and the other groups – Hindu, Christian or the others – is high among those in the age group 6-14 years. The difference was more pronounced among the older children.

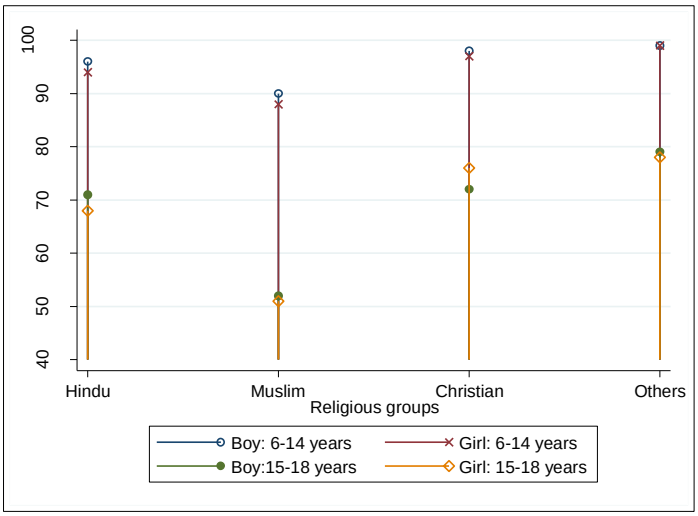

Figure 3: Percentage of children aged 6-14 years and 15-18 years attending school in 2017-18 by religious groups
Source: NSSO Survey of Education 2017-18

An examination of current school attendance by the state of residence deserves merit because of multiple reasons. The RTE Act was implemented in 2010[7] and based on the RTE Act, each state government formulated its own RTE state rule and implemented it in their states. Figure 4 (Table 4) shows the differences in school attendance by state. Near-universal school attendance can be seen for the younger age group of 6-14 years across multiple states, but differences across the state persist. In the states of Bihar and Uttar Pradesh, the percentage of children who were attending school was lower than the national average. The differences by gender show that the school attendance of girls was lower than that of the boys, and more prominent in the rural sector. On the other hand, the southern states of Tamil Nadu and Kerala had near-universal attendance in the elementary stage. The attendance among the older age group too was relatively higher in these states.

[7] The Act was extended to all states and UTs in 2010 except Jammu and Kashmir because of its special status

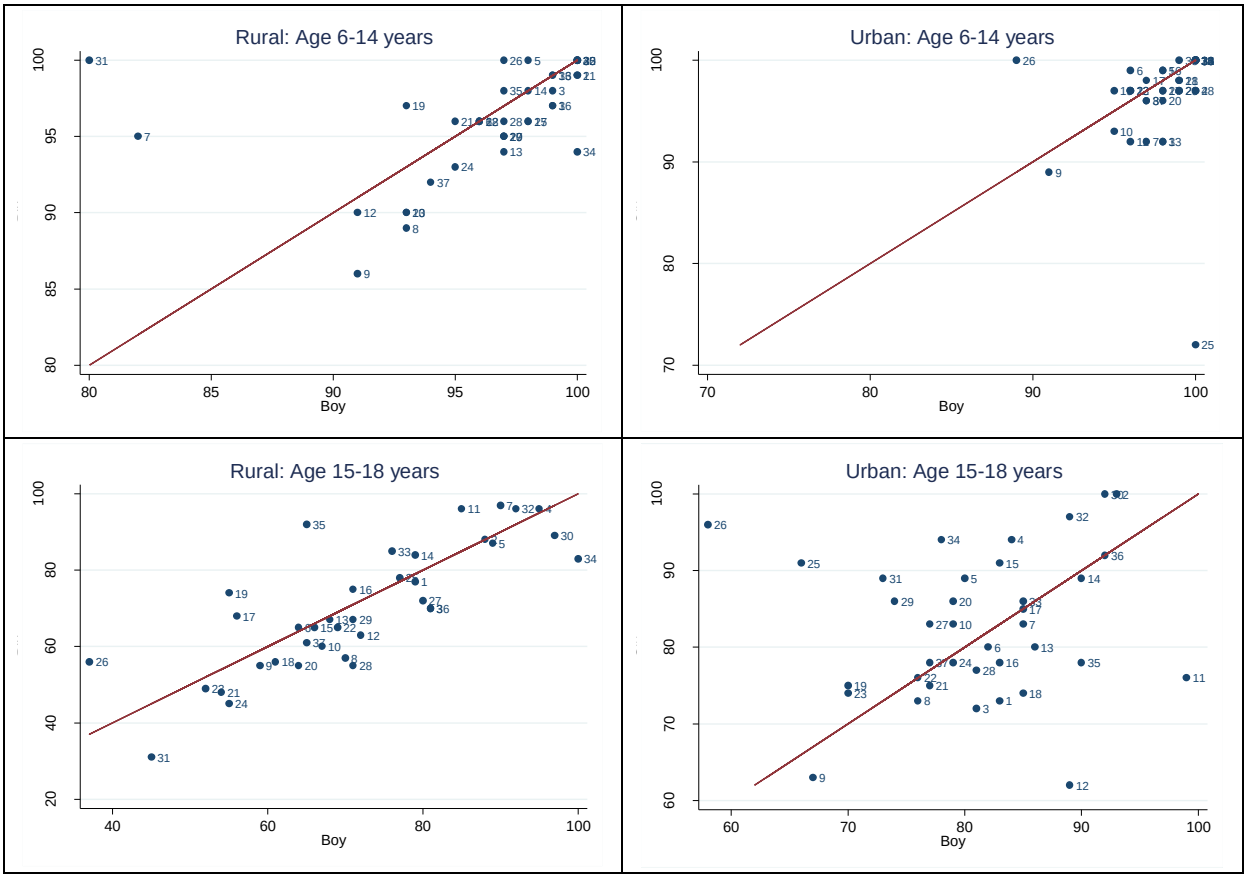

Figure 4: Percentage of children aged 6-14 years and 15-18 years attending school in 2017-18
Source: NSSO Survey of Education 2017-18
Note: State codes are presented in Table 14

One of the major areas of focus in the education policies, aside from bridging the gaps among social and religious groups, was to bridge the gap among socio-economic groups. To understand the differences, we classify the households into four groups based on their sector of residence. That is, the households in the rural sector were classified into four quartiles based on their MPCE and those in the urban sector were classified into four quartiles.

Figure 5 (Table 5) shows the percentage of children attending school by monthly per-capita consumption expenditure, separately by gender and sector. It can be seen that percentage of children attending school increases with an increase in the consumption quartile. The gender difference was more prominent in the lowest consumption quartile, but it fell with an increase in the consumption quartile.

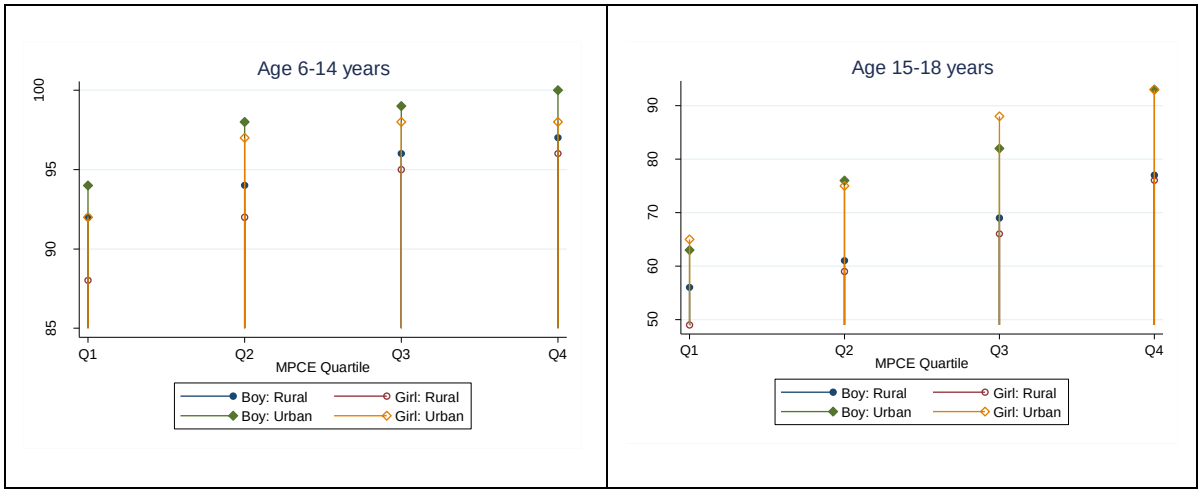

Figure 5: Percentage of children aged 6-14 years and 15-18 years attending school in 2017-18 by MPCE quartiles

Note: The scales are different in the figures

Source: NSSO Survey of Education 2017-18

A pattern that emerges through the analysis of this data is that over 90 percent of the children in the age group of 6-14 years were in school, in most of the sub-groups of analysis. A higher proportion of the younger group are in the schools hence their digital competency can be built in the schools. However, some of the students remain hard to reach and the heterogeneity only increases with an increase in age.

Given this scenario, how can requisite skills be built to make the students ready for the future? One solution is to provide AI-powered education to reach and upskill the children who are out of school. AI can personalise learning and help learners transition back to school. It can reach learners in remote locations and help them learn at their pace. But do these children possess the requisite infrastructure to reap the benefits of AI? In the other words, do they have digital devices and internet facilities at home? Do they know how to use the devices and the internet? We turn to these questions on the digital divide in the next section.

3 Digital divide in India: Examining recent trends

The nationally representative surveys in India have been collecting household and individual data on school enrolment, attendance and completion for decades. However, there was so systematic data collection on possession and use of digital devices until recently. The 71st round in 2014 and the 75th

round in 2017-18 are two surveys on education conducted by NSSO that collected information on the possession of devices and use of technology among households in India.

The survey on 'Social Consumption: Education' was conducted as a part of the 71st round of surveys conducted by NSSO (Government of India, 2015). This round was conducted from January to June 2014 covering a total of 4577 villages and 3720 blocks in rural and urban sectors respectively. In each of the sample villages or urban blocks, 8 households were selected to take part in the survey. Overall, 36,479 households were surveyed in rural India and 29,447 households were surveyed in urban India. This round collected information on whether the household had a 'computer' and whether any member of the household (aged 14 years or more) has access to use the internet facility. According to the survey, possession of a 'computer' included having a desktop, laptop, palmtop, notebook, netbook, smartphone, tablets, or other devices. The survey had questions on whether any member aged 14 years or above had access to use the internet facility[8].

The data suggest that in rural India, only 6 percent of households possessed a digital device, but 16 percent of households had access to internet facilities in 2014. The access to devices and internet facilities was higher in the urban sector, where 29 percent of the households had access to devices and 49 percent had access to internet facilities. At an all-India level, 14 percent of the households had access to devices and only 27 percent had access to internet facilities in 2014.

The possession and use of devices varied considerably by the MPCE quartiles. As seen in Figure 6 (Table 6), richer households were more likely to possess a device, as well as have access to use internet facilities. The rural sector had a lower difference between the top-most and the bottom-most MPCE quartile. In the urban sector the difference was starker across the MPCE quartiles.

[8] According to the definition followed in the survey, a household need not have possessed internet facilities but were required to have an access to internet.

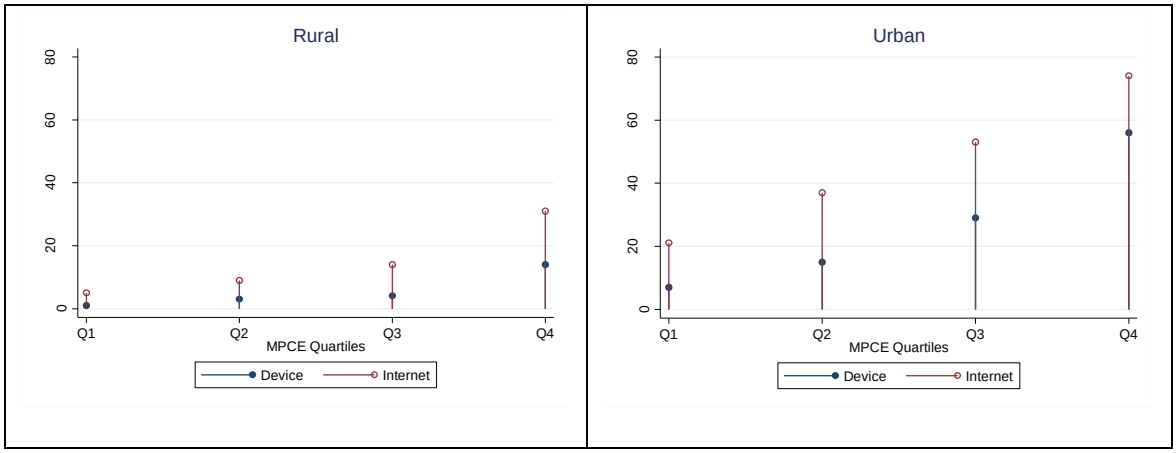

Figure 6: Percentage of households having access to devices and internet by MPCE quartiles
Source: NSSO Survey of Education 2017-18

The data gives us some insights into the possession and use of devices, but the detailed data on the use of devices and the internet was only collected for a sub-set of individuals. In the survey design, the 71st round considered the lower limit of age to be 14 years for most of the questions related to possession and the use of technology. For instance, data on the ability to use a computer, or having an access to the internet facility was only collected for individuals who were at least 14 years old. This excluded a major group of 6–14-year-olds who were receiving compulsory education under the RTE Act. For this, we analyse data from NSSO's Survey of Education 2017-18.

The 75th round collected information on possession and ability to use the device, ability to use the internet, and the actual use of the internet in the month before the survey. In this survey, the devices that were referred to as 'computers' include desktops, laptops, palmtops, notebooks, netbooks, tablets, or other similar handheld devices. However, unlike the previous survey, it did not include smartphones. Hence, the percentages that are represented in the tables are not comparable across the years.

The survey asked whether the household possessed a device that was generally available for use by the members, where the device may or may not be owned by them. Households with internet facilities included those households where the internet was generally available for use by all members of the household at any time, regardless of whether it was used. The 75th round collected information regarding the possession and use of devices and the internet for all individuals who were at least 5 years old. Thus, data from this round can provide more insights about the possession and use of devices and internet

facilities for the younger age group. We find that only 4 percent of the households in rural India and 23 percent in urban India had access to digital devices in 2017-18. This, as specified earlier, does not include possession of smartphones which is likely to be much higher. The access to internet facilities was higher in both urban and rural sectors. 15 percent of the households in the rural sector and 41 percent of the households in the urban sector had internet facilities.

There were wide variations by the state and sector of residence. As evident from Figure 7 (Table 7), the share of households that had access to internet facilities was always higher than those that possessed a device. Furthermore, the households in the urban sector had a higher share of devices as well as a higher share of internet facilities. Only around 5 percent of households in Andhra Pradesh, Bihar, Jharkhand, Odisha possessed a digital device. Their respective shares were even lower in their rural sectors. In these states, less than 20 percent of the households possessed an internet connection.

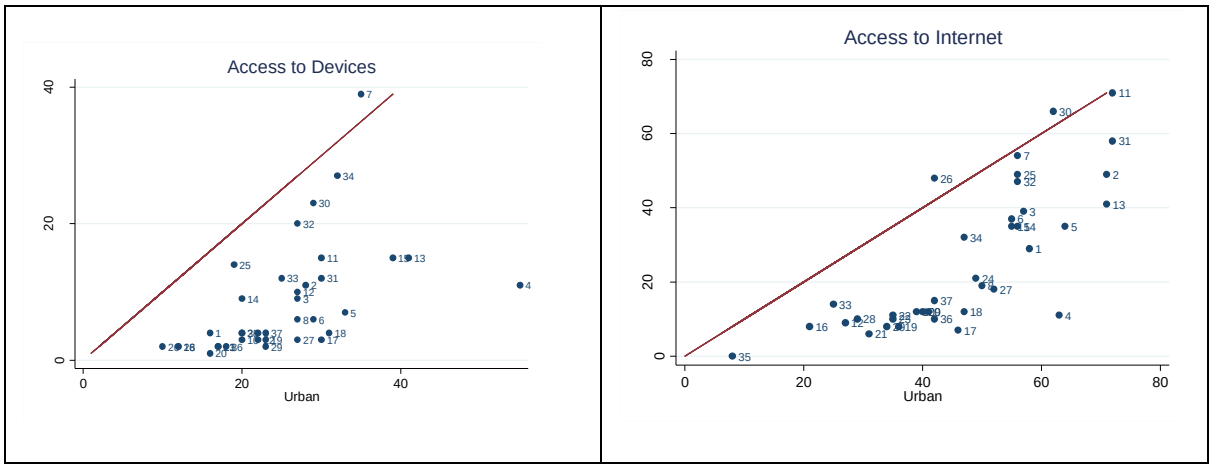

Figure 7: Percentage of households having access to devices and internet in 2017-18 by states
Source: NSSO Survey of Education 2017-18
Note: State codes are presented in Table 14

Similar to the observed trend in 2014, it can be seen that the richer households were more likely to possess a digital device or an internet facility. The households in the lowest consumption quartile were the least likely to either possess a device or possess an internet facility. Only 2 percent of households in the lowest quartile possessed a digital device (Table 8). Even if we consider the households in the topmost quartile, less than 30 percent of households possessed a device, and less than 50 percent had internet access.

The overall possession of a device by household masks certain important differences. For instance, who, among the members can use the devices? We unpack information at the individual level for answering this question. We examine the patterns for individuals aged 6-18 years in Figure 8 (Table 9). It can be seen that the skills to operate a device or use the internet were more prevalent among households from a higher consumption quartile. Furthermore, at every MPCE quartile, a greater share of boys had the necessary skills to operate a device or use the internet relative to the girls. A similar pattern was seen for the use of the internet as well.

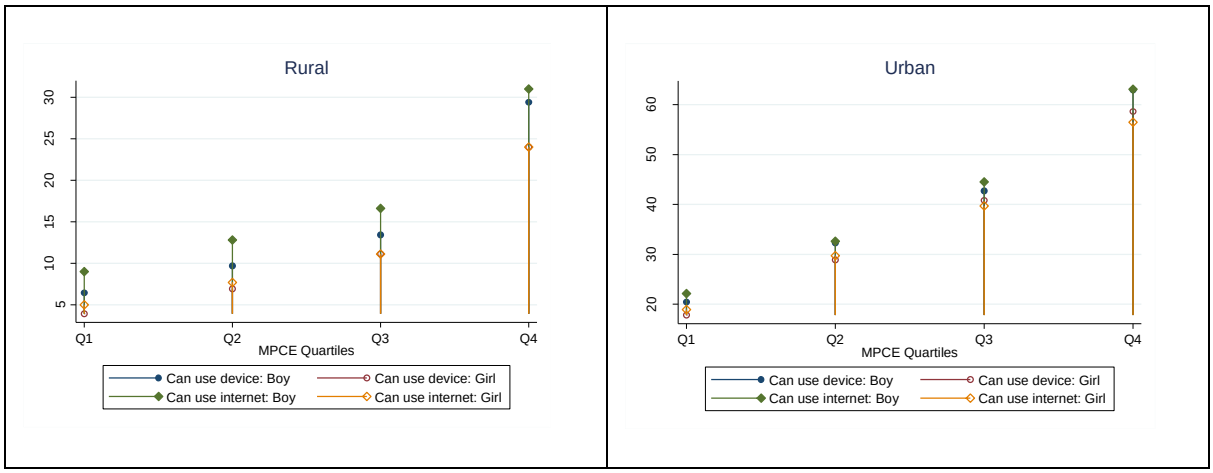

Figure 8: Percentage of individuals aged 6-18 years who can use devices and internet by MPCE quartiles in 2017-18.
Source: NSSO Survey of Education 2017-18
Note: The scales are different in the figures

The gender differences in the use of devices and skills are also prominent if we classify children by their state of residence (Table 10). In most of the major states of India, the boys were more skilled in using a device or the internet, compared to the girls in those states (Figure 9). The gender differences were more prominent in the ability to use the internet.

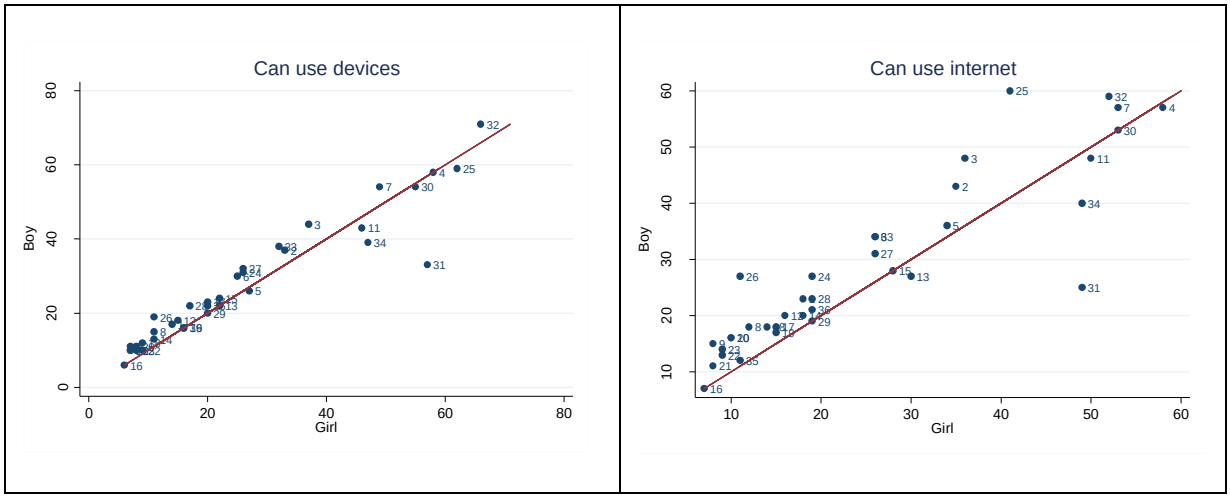

Figure 9: Percentage of children aged 6-18 years who can use devices and internet by states
Source: NSSO Survey of Education 2017-18
Note: The scales are different in the two figures. State codes are presented in Table 14

We examine how the education of the household is associated with a child's ability to use devices and internet facilities. Figure 10 (Table 11) shows the differences in skills by age group and education of household head. The ability to use devices or internet facilities increases with an increase in age, with individuals in the older age group more able than the ones in the younger age group. Within each age group it can be seen that the ability increases with an increase in the education level of the household head. Even within each educational level, it can be seen that boys outperform girls. The difference was starker for the older age group.

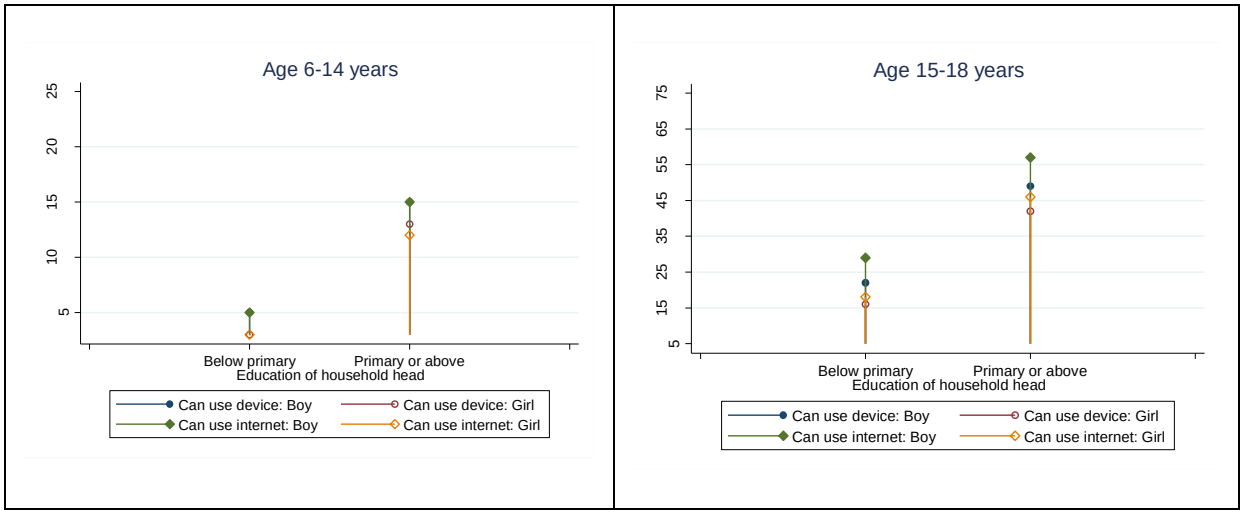

Figure 10: Percentage of children aged 6-18 years who can use devices and internet by education of household head
Source: NSSO Survey of Education 2017-18
Note: the scales are different in the two figures

We do a sub-sample analysis based on the individuals aged 6-18 years who were attending school. It was to examine how the ability to use devices and the internet varied by the type of schools attended by children. The result suggests that in both the age groups, a higher percentage of children in private schools were able to use devices as well as the internet (Table 12). This is not a surprising result given that school choices in India are linked to the household consumption expenditure, and we have seen children from higher MPCE quartiles were more likely to be able to use devices and the internet than those from lower MPCE quartiles (Table 9).

Overall, the results suggest that children in the rural sector were at a disadvantage compared to children in the urban sector in both possession of devices and use of the internet. Even among the sectors, girls and those from the lower consumption expenditure quartile faced further disadvantages.

We estimate two logit models with the outcome variable as the ability to use a device and the ability to use the internet. We are specifically interested to see how use of devices and the internet vary by gender, controlling for the other aforementioned factors that can affect the ability. More specifically, we estimate the following model

$$Ability_{ihs} = \alpha + \beta_1 gender_{ihs} + \beta_2 age_{ihs} + \beta_4 HH_{hs} + \gamma_s + \varepsilon_{ihs}$$

In this model, the outcome variable 'Ability' is the ability to use devices in the first model and the ability to use internet in the second model. It is a binary variable taking 1 or 0 depending on whether or not the individual can use devices or the internet. Among individual factors, the model controls for the age of the individual. The main variable of interest is gender. Household controls include religion, social groups, household type[9], MPCE quartiles, household size and education of the household head (below primary/ primary and above). State fixed effects are accounted for in the model and robust standard errors are estimated. The model is estimated separately for rural and urban sectors, and the age groups considered are 6-14 years and 15-18 years. The results are presented in Table 13. The results show that

[9] Type of household is determined by the main source of income of the household in the year before the survey. The classification is done on the basis of the sector of residence.

the gender difference remains significant in all the models, despite controlling for all the other factors. This is seen across both the age groups and across the sector of residence.

The results obtained in the two sections affirm the statement that marginalised children are more likely to be out of school and are less likely to possess digital devices and internet facilities. This suggests, that with the advent and use of technology in education the digital divide and persisting inequalities are only likely to become deeper without timely and proper external intervention.

4 Use of Technology in Education: The Road Ahead

The year 2020 marked a decade of the implementation of the RTE Act and enrolment of children has reportedly increased over time. 2020 also marks the year in which India passed NEP after a gap of three decades from the previous National Policy on Education, 1986. This section will highlight the discussion undertaken in NEP 2020 related to the use of technology in education. Additionally, it will discuss the initiatives taken by various state governments.

4.1 Evidence from Policy Documents

NEP 2020 discusses technology use and integration, and ensures equitable use of technology as two key focus areas (Government of India, 2020a). The policy document acknowledges the bi-directional relation between technology and education – the critical role of education in the transformation of India into a digitally empowered society and the critical role of technology in the improvement of educational processes and outcomes.

As a part of ensuring equitable use of technology, NEP acknowledges the digital divide that is prevalent in the country and encourages alternate media like radio, television, and community radio for telecasts and broadcasts. It emphasises on the need of building the digital infrastructure of India, the creation and effective use of online teaching, virtual labs, and supporting the teachers through necessary training. Additionally, NEP encourages the state governments to create and disseminate quality content and

digital repository[10]. The children are kept at the center of learning by suggesting the use of appropriate pedagogy in online learning, and blending screen-based education with hands-on learning. The policy encourages attention to diversity in terms of regional languages and the use of regional languages in education technology.

Within technology, NEP highlights the 'disruptive' nature of AI and discusses what it could mean for school education. The policy states that the education system must be poised to respond quickly to the changing nature of technology and its implication for the future. In response to better understand and address the scope of AI, the National Research Foundation would adopt a three-pronged approach. These are: expanding the core-AI research, developing and deploying application-based research, and advancing international research efforts to address global challenges in areas such as healthcare, agriculture, and climate change using AI (Government of India, 2020a). To make the students better prepared for the future and reap the benefits of AI, NEP focuses on building mathematical skills, computational thinking, and digital skills from an early age. Suggestions to include AI in pedagogical strategies and curriculum were also emphasised.

The implementation plan of NEP elaborates on the targets, timelines, and long-term goals to be achieved by the states (Government of India, 2020b). The achievements to be reached by 2025 include building teacher capacity across states, integration of technology and education, and the effective utilization of the budget allocated under this head. There is a plan to integrate the schools in the Special Education Zones[11] and Aspirational Districts[12] with digital devices on priority. The states are asked to plan their budget and present it to the central government for approval. The ministries are aligned to produce and market useful, affordable, and maintainable digital devices which could be used by the students. The

[10] DIKSHA is an initiative of the National Council of Educational Research and Training (Ministry of Education, Govt of India). It is an online repository where more than 22 states and UTs have published their content. For more details see: https://diksha.gov.in/

[11] NEP 2020 recommends 'regions of the country with large populations from educationally-disadvantaged [Socio-Economically Disadvantaged Groups] SEDGs should be declared Special Education Zones (SEZs), where all the schemes and policies are implemented to the maximum through additional concerted efforts, in order to truly change their educational landscape' (pp. 26, Government of India, 2020a).

[12] For more details on Aspirational Districts see https://www.niti.gov.in/aspirational-districts-programme

policy suggests that the states should adopt and support the scale-up of the use of technologies to improve multiple aspects of education.

4.2 Exploring State Initiatives

The states have started adopting various modes of using technology in education guided by the local needs and respective contexts. Each state submits a Work Plan & Budget (AWP&B) every year to seek funds under the Samagra Shiksha scheme. We draw on the minutes of the Project Approval Board (PAB) meeting for the year 2021-22 that are submitted by each state[13], and official documents by state governments to illustrate initiatives taken by various states. We reflect on the findings through the lens of the existing literature to examine what interventions mean for children in the state.

The state government of West Bengal planned the distribution of tablets to children in higher-secondary grades in state-run or state-aided higher secondary schools (The Hindu, December 3, 2020). The PAB 2021 minutes for West Bengal state that the state had initiated a scheme '*Taruner Swapna Prakalpa*' using which, the state would provide financial assistance to children from Grade 12 so that they could purchase tablets or smartphones (Government of West Bengal, 2021). This was initiated to bridge the digital divide so that individuals could continue learning in an online mode. Under this arrangement, the state provided each child with 10,000 rupees (~130 USD) and a total of 8.5 lakh (0.85 million) children were likely to be benefitted.

The Government of Chhattisgarh acknowledged the lack of smartphones, telephone networks, and internet in the rural regions of the state. The state took active steps to reach the students through their feature phones or landlines (Government of Chhattisgarh, 2020) but the success of such steps remains unknown. The Government of Telangana surveyed to understand the existing digital divide among children in Grades 3-10. The government surveyed 1.6 million children and found that 46 percent of the surveyed students had a smartphone with internet access and 3 percent had access to a desktop or laptop with internet access (Government of Telangana, 2021). After understanding the prevalent gap,

[13] The comprehensive list for all states can be obtained here: https://dsel.education.gov.in/pab-minutes

the students who did not have access to digital devices were paired with individuals – peers, alumni, and Gram Panchayat – who had access to digital devices.

The literature suggests that only hardware-oriented intervention has not resulted in a positive impact on learning outcomes (Barrera-Osorio & Linden, 2009; Beuermann et al., 2015; Cristia et al., 2017; Malamud & Pop-Eleches, 2011). Beuermann et al (2015) evaluate the effect of the One Laptop per Child (OLPC) programme in Peru but did not find a positive effect of providing laptops to each child on the academic achievement of children or their cognitive skills. The effect of OLPC was further analysed by collecting data from 318 schools, 15 months after the implementation of the programme (Cristia et al., 2017). The authors noted an increase in the use of computers in both home and school, but no effect on test scores in Mathematics or language. The study did find evidence of an improvement in the general cognitive skills of the students, but the results were not conclusive. In Romania, children who won vouchers and purchased home computers had higher computer skills but significantly lower school grades (Malamud & Pop-Eleches, 2011).

Focusing on one data point, that of student test scores is not a sufficient measure of student learning in the fuller sense (Burns 2021). These evidences taken together suggest that the interventions might not be sufficient to increase learning outcomes of the students by themselves, but can enhance computer skills or general cognitive skills of the students. Effective use of the devices could be in line with NEP 2020 which focuses on developing digital skills and computational thinking skills among the students. Moreover, the distributed devices with the appropriate educational technology in place, could help these students to upskill themselves, prepare for competitive examinations and continue learning even outside the boundaries of the school. The choice of the appropriate educational technology needs to be based on research and the questions related to resources and who procures them remain unanswered.

The Government of Uttar Pradesh planned to distribute tablets to secondary schools at the cost of 10,000 rupees per tablet per school (Government of Uttar Pradesh, 2021). An outlay of 220.4 lakh (22.04 million) rupees was estimated for reaching 2,204 secondary schools. This was done to help schools to monitor learning outcomes, conduct assessments and analysis of results, and perform such actions as necessary to improve learning outcomes and quality of learning. A similar initiative was already in

place for the elementary grades, but in neither of the cases, was it aimed to reach the students directly. Having a device in school could be very beneficial if it is followed by capacity building of the intended stakeholders. For instance, teachers spend a major portion of their time on routine administrative work. Unified District Information System for Education Report[14] for 2016-17 suggests that teachers in the states of Bihar, Nagaland and Uttarakhand had spent for more than a month completing non-teaching assignments. Under a dual-teacher model with the help of AI, a virtual teaching assistant could perform the routine activities and free up time for the teachers to teach and focus on individual learners (Pedro et al, 2019). AI can be used as an assessment tool to grade assessments and free-up time of the teachers. These practices can be beneficial for the teachers as well as students but would require further investment in education technology from the side of the state government and building the capacity of teachers involved.

The government of Haryana aims to provide learners with hardware along with associated software that can benefit the learners. In mid-2021, Haryana Education Minister had announced that children from Grades 8-12 would be distributed free tablets so that the children could pursue online education. The state government floated tenders to procure tablets and adopt Personalised Adaptive Learning (PAL) Software for this. The literature suggests that the use of technology that allows for personalised instruction leads to the largest gains in learning outcomes (Banerjee et al., 2007; Muralidharan et al., 2017).

According to the Economic Survey of Haryana for 2021-22, a total of 14,355 tablets have been approved in 2019-20 (Government of Haryana, 2022). They have been procured and supplied to schools by incurring an expenditure of 176 million during 2021-22. More recently in early 2022, questions were raised in Haryana State Legislative Assembly regarding the timeline of implementation of this scheme[15]. The response from the state indicated that the students in Grades 10 - 12 would be receiving the tablets with pre-loaded software in mid-2022. According to the tender[16] that was shared for

[14] http://udise.in/Downloads/Elementary-STRC-2016-17/Elementary-State_Report_Cards_2016-17.pdf
[15] https://haryanaassembly.gov.in/wp-content/uploads/2022/03/Starred-Questions-07.03.2022-English.pdf
[16] The tender was downloaded from the following website of the Government of Haryana: https://etenders.hry.nic.in

procurement of PAL software, the state government undertook the selection of software by undertaking thorough considerations of quality, to ensure that the procured product could improve the learning outcomes of the students. The government of Madhya Pradesh had released a call for proposals to procure PAL products for teaching Mathematics and English to students in Grades 6-8[17]. This was proposed to operate in 1,217 schools out of the 2,592 Secondary and Higher Secondary schools in the state to provide personalised and tailored instructions to enhance their learning outcomes.

Research-backed evidence to support the government adoption decisions is emerging (Patel et al, 2021) and the increased interest in considering quality learning software besides procuring hardware deserves merit. The way ahead for the state governments would not only be to bridge the digital divide by procuring devices, but also to procure quality software that can enhance the learning outcomes of the students, help teachers deliver focused interventions and improve education system as a whole.

5 Conclusion and Direction for Future Research

Globally, out of the 16.2 billion dollars that were invested in education technology in 2020, 80 percent of the investment was driven by Asian countries – primarily China and India (Burns, 2021). The use of education technology has further risen by the sudden surge in distance education due to the long periods of school closures due to the outbreak of the COVID-19 pandemic. This paper shows that, while India has seen a near-universal enrolment rate in elementary education, the increase in the use of technology has opened up a different form of inequality in the educational space. It has magnified the inequality in opportunities due to the digital divide and further pushed certain sub-groups of children to the margin.

Evidence from the Annual Status of Education Report 2021 shows that with ongoing distance education due to COVID-19, there has been a further surge in the use of digital devices in India. The 2021 ASER report suggests that 67.6 percent of children who were enrolled in school had a smartphone available at home (ASER, 2021). The corresponding figure was 36.5 percent in 2018. The level of education of

[17] The tender was downloaded from the following website of the Government of Madhya Pradesh: https://mptenders.gov.in

parents posed to be an important factor in the possession of a smartphone at home. Evidence suggests that 52 percent of children had a smartphone when both the parents had an education of less than Grade 5, and, 68 percent of children reported having a smartphone when both the parents had an education of at least Grade 9. The level of access masks the inequality in the availability of the device. Although 67.6 percent of children reported having a smartphone at home, only 27 percent reported having the smartphone available at all times, whereas 26 percent of children reported that they were inaccessible to them. This brings out the disparity in the availability of the device and their use across India. Our previous analysis highlighted that the availability of digital devices across India was low, and in all probability, the access to these devices was even lower.

The paper covers only the aspect of access to digital devices and the internet. The use of technology has also opened up questions in various dimensions; it ranges from access to devices to capacity building of teachers on the use of technology in education, the use of appropriate pedagogy, governance, and regulations, to quality adoption decisions by various state governments (UNESCO, 2022). Additionally, some of the open questions that emerge from our studies are: How can the use of technology in education reach the last mile of children? How much can be left to the choice of household and what part needs to be addressed by the state governments? Is the bigger conversation about bridging the divide in digital devices or is it about what the children do with the devices that matter? In that sense, what would the role of teachers be in the teaching-learning process? The ways in which the myriad factors interact with each other, and the ways in which the system-wide conditions are met, will determine the potential of technology to enhance learning. The research in the field is relatively nascent but is increasingly gaining traction and this topic is getting reflected in the national policies as well.

NEP 2020 brings out the urgency of the use of technology in education and shares strategies which the states can implement. In line with what we discussed; certain state governments have taken active states to bridge the gap in access to devices. Some of the others have moved beyond procuring devices and have also begun procuring quality software to benefit the learners. The needs of the state governments vary based on their local needs, context and there is no one-size-fits-all policy that can benefit the states uniformly.

Research will need to inspect factors that pose as enablers and barriers to the use of technology, ways to bridge the digital gap and help governments in the process of adoption. It will also help in identifying the role of teachers and parents to ensure meaningful use of technology in education, at school, and at home. Future research can examine some of these aspects and provide a more nuanced understanding of the use of technology in education, ways to best bridge gaps in access, and ensure that technology can reach and improve educational outcomes of the last mile of students.

REFERENCES

ASER (2021) Annual Status of Education Report (Rural) 2021, ASER Centre, New Delhi, India. http://img.asercentre.org/docs/aser2021forweb.pdf

Azam, M., & Saing, C. H. (2017). Assessing the Impact of District Primary Education Program in India. *Review of Development Economics*, *21*(4), 1113–1131. https://doi.org/10.1111/rode.12281

Banerjee, A. V., Cole, S., Duflo, E., & Linden, L. (2007). Remedying education: Evidence from two randomized experiments in India. *Quarterly Journal of Economics*, *122*(3), 1235–1264. https://doi.org/10.1162/qjec.122.3.1235

Barrera-Osorio, F., & Linden, L. L. (2009). The use and misuse of computers in education: Evidence from a randomized experiment in Colombia. In *Policy Research Working Paper Series* (No. 29; Impact Evaluation Series, Issue 4836). http://go.worldbank.org/BZZT7KNLG0

Beuermann, D. W., Cristia, J., Cueto, S., Malamud, O., & Cruz-Aguayo, Y. (2015). One Laptop per Child at Home : Short-Term Impacts from a Randomized Experiment in Peru. *American Economic Journal: Applied Economics*, *7*(2), 53–80. https://doi.org/http://dx.doi.org/10.1257/app.20130267

Burns, M (2021) Technology in education, Paper commissioned for the 2023 Global Education Monitoring Report, Technology and education. https://unesdoc.unesco.org/ark:/48223/pf0000378951/PDF/378951eng.pdf.multi

Chatterjee, I., Li, I., & Robitaille, M.-C. (2018). An overview of India's primary school education policies and outcomes 2005- 2011. *World Development*, *106*, 99–110. https://doi.org/10.1016/j.worlddev.2018.01.016

Cristia, J., Ibarrarân, P., Cueto, S., Santiago, A., & Severin, E. (2017). Technology and Child Development : Evidence from the One Laptop per Child Program. *American Economic Journal: Applied Economics*, *9*(3), 295–320. https://doi.org/https://doi.org/10.I257/app.20150385

Das, A. (2007). How Far Have We Come in Sarva Siksha Abhiyan? *Economic and Political Weekly*, *42*(1), 21–23. http://www.jstor.org/stable/4419104

Datta Gupta, N., Dubey, A., & Simonsen, M. (2018). Rising school attendance in rural India : an evaluation of the effects of major educational reforms. *Education Economics*, *26*(2), 109–128. https://doi.org/10.1080/09645292.2017.1387887

Goel, S., & Husain, Z. (2018). Gender, caste, and education in India: A cohort-wise study of drop-out from schools. *Research in Social Stratification and Mobility*, *58*, 54–68.

https://doi.org/10.1016/j.rssm.2018.10.002

Government of Haryana (2022) Economic Survey of Haryana 2021-22, Department of Economic and Statistical Analysis, Haryana. http://web1.hry.nic.in/budget/Esurvey.pdf

Government of India (2011) Sarva Shiksha Abhiyan Framework for Implementation of the Right of Children to Free and Compulsory Education Act, 2009, Ministry of Human Resource Development, Government of India. https://www.education.gov.in/en/sites/upload_files/mhrd/files/upload_document/SSA-Frame-work.pdf

Government of India (2015) Social Consumption - Education Survey: Round 71, Schedule 25.2 , January 2014 -June 2014, Ministry of Statistics & Programme Implementation, National Sample Survey Office, Government of India

Government of India (2019) Household Social Consumption: Education, NSS 75th Round, July 2017-June 2018, Ministry of Statistics & Programme Implementation, National Sample Survey Office, New Delhi, India

Government of India (2020a) National Policy Policy 2020, Ministry of Human Resource Development, New Delhi, India. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

Government of India (2020b) SARTHAQ, Students' and Teachers' Holistic Advancement Through Quality Education, Department of School Education and Literacy, Ministry of Education. https://dsel.education.gov.in/sites/default/files/SARTHAQ_Part-1_updated.pdf

Government of Chhattisgarh (2020) Minutes of the meeting of the Project Approval Board, Department of School Education & Literacy, Ministry of Education, Government of India. https://dsel.education.gov.in/sites/default/files/2020-09/chhattisgarh.pdf

Government of West Bengal (2021) Minutes of the meeting of the Project Approval Board, Department of School Education & Literacy, Ministry of Education, Government of India. https://dsel.education.gov.in/sites/default/files/2021-09/pab_wb_21.pdf

Government of Telengana (2021) Minutes of the meeting of the Project Approval Board, Department of School Education & Literacy, Ministry of Education, Government of India. https://dsel.education.gov.in/sites/default/files/2021-10/PAB_Minutes_Telangana.pdf

Government of Uttar Pradesh (2021) Minutes of the meeting of the Project Approval Board, Department of School Education & Literacy, Ministry of Education, Government of India. https://dsel.education.gov.in/sites/default/files/2021-09/pab_up_21.pdf

Hilbert, M. (2016). Big data for development: A review of promises and challenges. Development Policy Review, 34(1), 135-174. https://doi.org/10.1111/dpr.12142

Husain, Z., & Chatterjee, A. (2009). Primary completion rates across socio-religious communities in West Bengal. *Economic and Political Weekly*, *44*(15), 59–67.

Malamud, O., & Pop-Eleches, C. (2011). Home computer use and the development of human capital. *Quarterly Journal of Economics*, *126*, 987–1027. https://doi.org/10.1093/qje/qjr008

Muralidharan, K., Singh, A., & Ganimian, A. J. (2017). *Disrupting Education? Experimental Evidence on Technology-Aided Instruction in India* (No. 22923; NBER Working Paper Series). http://www.nber.org/papers/w22923

Patel, A., Dasgupta, C., Murthy, S., & Dhanani, R. (2021). Co-Designing for a Healthy Edtech Ecosystem: Lessons from the Tulna Research-Practice Partnership in India. Rodrigo, MMT et al.

(Eds.).

Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education: Challenges and opportunities for sustainable development. https://unesdoc.unesco.org/ark:/48223/pf0000366994/PDF/366994eng.pdf.multi

Shah, M., & Steinberg, B. (2019). The Right to Education Act : Trends in Enrollment , Test Scores, and School Quality. *AEA Papers and Proceedings*, *109*, 232–238. https://doi.org/https://doi.org/10.1257/pandp.20191060

The Hindu, December 3. (2020) Bengal government to give 9.5 lakh tablets to higher secondary students for online classes, Shiv Sahay Singh https://www.thehindu.com/news/national/other-states/bengal-government-to-give-95-lakh-tablets-to-higher-secondary-students-for-online-classes/article33243523.ece

UNESCO (2016) Incheon Declaration and Framework for Action for the implementation of Sustainable Development Goal 4, http://uis.unesco.org/sites/default/files/documents/education-2030-incheon-framework-for-action-implementation-of-sdg4-2016-en_2.pdf

UNESCO (2022) Concept note for the 2023 Global Education Monitoring Report on technology and education. https://unesdoc.unesco.org/ark:/48223/pf0000378950/PDF/378950eng.pdf.multi

Appendix

Table 1: Percentage of children attending school by age group, gender, and sector of residence in 2017-18

	Boys			Girls		
Age group	Rural	Urban	Total	Rural	Urban	Total
6-14 years	94	97	95	92	96	93
15-18 years	65	77	68	61	78	66

Source: Author's calculation from NSSO's Survey of Education 2017-18

Table 2: Percentage of children attending school by social group and gender in 2017-18

	6-14 years			15-18 years		
Social groups	Boys	Girls	Total	Boys	Girls	Total
Scheduled Tribe	92	90	91	56	49	53
Scheduled Caste	94	93	94	61	63	62
Other Backward Classes	95	92	94	70	66	68
Other	97	96	96	77	76	76
Total	95	93	94	68	66	67

Source: Author's calculation from NSSO's Survey of Education 2017-18

Table 3: Percentage of children attending school by religious groups and gender in 2017-18

	6-14 years			15-18 years		
Religious groups	Boys	Girls	Total	Boys	Girls	Total
Hindu	96	94	95	71	68	70
Muslim	90	88	89	52	51	51
Christian	98	97	98	72	76	74
Other religious minority groups	99	99	99	79	78	79
Total	95	93	94	68	66	67

Source: Author's calculation from NSSO's Survey of Education 2017-18

Table 4: Percentage of children attending school by state, sector of residence, and gender in 2017-18

State	Age 6-14 years				Age 15-18 years			
	Rural		Urban		Rural		Urban	
	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl
Jammu and Kashmir	99	97	96	97	79	77	83	73
Himachal Pradesh	100	99	100	100	88	88	93	100
Punjab	99	98	98	92	81	70	81	72
Chandigarh	100	100	100	97	95	96	84	94
Uttarakhand	98	100	98	99	89	87	80	89
Haryana	96	96	96	99	64	65	82	80
Delhi	82	95	97	92	90	97	85	83
Rajasthan	93	89	97	96	70	57	76	73
Uttar Pradesh	91	86	91	89	59	55	67	63
Bihar	93	90	95	93	67	60	79	83
Sikkim	100	99	100	100	85	96	99	76
Arunachal Pradesh	91	90	96	92	72	63	89	62
Nagaland	97	94	98	92	68	67	86	80
Manipur	98	98	98	97	79	84	90	89
Mizoram	98	96	100	100	66	65	83	91
Tripura	99	99	98	99	71	75	83	78
Meghalaya	97	95	97	98	56	68	85	85
Assam	96	96	99	98	61	56	85	74
West Bengal	93	97	95	97	55	74	70	75
Jharkhand	97	95	98	96	64	55	79	86
Odisha	95	96	99	98	54	48	77	75
Chhattisgarh	96	96	96	97	69	65	76	76
Madhya Pradesh	93	90	96	97	52	49	70	74
Gujarat	95	93	99	97	55	45	79	78
Daman & Diu	100	100	100	72	77	78	66	91
Dadra & Nagar Haveli	97	100	89	100	37	56	58	96
Maharashtra	98	96	98	97	80	72	77	83
Andhra Pradesh	97	96	100	97	71	55	81	77
Karnataka	97	95	99	97	71	67	74	86
Goa	100	100	100	100	97	89	92	100
Lakshadweep	80	100	100	100	45	31	73	89
Kerala	100	100	100	100	92	96	89	97
Tamil Nadu	99	99	100	100	76	85	85	86
Puducherry	100	94	100	100	100	83	78	94
A & N Islands	97	98	99	100	65	92	90	78
Telangana	99	97	100	100	81	70	92	92
Total	94	92	97	96	65	61	77	78

Source: Author's calculation from NSSO's Survey of Education 2017-18. Note: Sample observations in rural Delhi, Chandigarh, Daman and Diu, Lakshadweep were less than forty, hence should be interpreted with caution.

Table 5: Percentage of children attending school by MPCE quartiles in 2017-18

	6-14 years				15-18 years			
	Rural		Urban		Rural		Urban	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Q1	92	88	94	92	56	49	63	65
Q2	94	92	98	97	61	59	76	75
Q3	96	95	99	98	69	66	82	88
Q4	97	96	100	98	77	76	93	93
Total	94	92	97	96	65	61	77	78

Source: Author's calculation from NSSO's Survey of Education 2017-18

Table 6: Percentage of households having access to devices and internet in 2014 by MPCE quartiles

	Access to devices			Internet Facility		
	Rural	Urban	Total	Rural	Urban	Total
Q1	1	7	2	5	21	6
Q2	3	15	4	9	37	13
Q3	4	29	8	14	53	23
Q4	14	56	33	31	74	53
Total	6	29	14	16	49	27

Source: Author's calculation from NSSO's Survey of Education 2014

Table 7: Percentage of households having devices and internet facility by state and sector of residence in 2017-18

State	The household possesses a device			The household has an internet facility		
	Rural	Urban	Total	Rural	Urban	Total
Jammu and Kashmir	4	16	7	29	58	36
Himachal Pradesh	11	28	13	49	71	51
Punjab	9	27	16	39	57	46
Chandigarh	11	55	53	11	63	61
Uttarakhand	7	33	14	35	64	44
Haryana	6	29	15	37	55	44
Delhi	39	35	35	54	56	56
Rajasthan	6	27	12	19	50	27
Uttar Pradesh	4	22	8	12	41	18
Bihar	3	20	5	12	39	15
Sikkim	15	30	20	71	72	71
Arunachal Pradesh	10	27	13	9	27	13
Nagaland	15	41	23	41	71	50
Manipur	9	20	13	35	56	42
Mizoram	15	39	26	35	55	44
Tripura	2	12	4	8	21	11
Meghalaya	3	30	9	7	46	15
Assam	4	31	7	12	47	17
West Bengal	3	23	9	8	36	17
Jharkhand	1	16	4	12	40	18
Odisha	2	17	4	6	31	10
Chhattisgarh	3	22	7	11	35	15
Madhya Pradesh	2	17	6	10	35	16
Gujarat	4	20	11	21	49	33
Daman & Diu	14	19	18	49	56	54
Dadra & Nagar Haveli	2	10	7	48	42	45
Maharashtra	3	27	14	18	52	34
Andhra Pradesh	2	12	5	10	29	17
Karnataka	2	23	11	8	34	19
Goa	23	29	27	66	62	64
Lakshadweep	12	30	25	58	72	69
Kerala	20	27	23	47	56	51
Tamil Nadu	12	25	18	14	25	20
Puducherry	27	32	30	32	47	41
A & N Islands	4	20	10	0	8	3
Telangana	2	18	9	10	42	25
Total	4	23	11	15	42	24

Source: Author's calculation from NSSO's Survey of Education 2017-18.

Table 8: Percentage of households having access to devices and internet in 2017-18 by MPCE quartiles

	Access to devices			Internet Facility		
	Rural	Urban	Total	Rural	Urban	Total
Q1	2	8	2	7	22	8
Q2	3	13	4	11	34	1
Q3	4	21	6	15	43	21
Q4	10	43	26	26	60	45
Total	4	23	11	15	42	24

Source: Author's calculation from NSSO's Survey of Education 2017-18

Table 9: Percentage of individuals aged 6 – 18 years who can use devices and internet by MPCE, gender and sector of residence in 2017-18

	Use of devices					
	Boys			Girls		
	Rural	Urban	Total	Rural	Urban	Total
Q1	6	20	7	4	18	5
Q2	10	32	12	7	29	9
Q3	13	43	21	11	41	18
Q4	29	63	46	24	59	41
Total	13	37	19	10	33	16
	Use of internet					
	Boys			Girls		
	Rural	Urban	Total	Rural	Urban	Total
Q1	9	22	10	5	19	6
Q2	13	33	15	8	39	10
Q3	17	45	23	11	40	18
Q4	31	63	47	24	57	41
Total	16	38	22	11	33	16

Source: Author's calculation from NSSO's Survey of Education 2017-18

Table 10: Percentage of children aged 6-18 years who can use devices and internet in 2017-18 by state

State	Can use a device			Can use internet		
	Boy	Girl	Total	Boy	Girl	Total
Jammu and Kashmir	17	14	15	23	18	21
Himachal Pradesh	37	33	35	43	35	39
Punjab	44	37	41	48	36	43
Chandigarh	58	58	58	57	58	58
Uttarakhand	26	27	26	36	34	35
Haryana	30	25	28	34	26	31
Delhi	54	49	52	57	53	55
Rajasthan	15	11	13	18	12	15
Uttar Pradesh	11	7	9	15	8	12
Bihar	10	7	9	16	10	14
Sikkim	43	46	45	48	50	49
Arunachal Pradesh	18	15	16	20	16	18
Nagaland	22	22	22	27	30	28
Manipur	13	11	12	20	18	19
Mizoram	24	22	23	28	28	28
Tripura	6	6	6	7	7	7
Meghalaya	23	20	21	18	15	16
Assam	12	9	11	18	14	16
West Bengal	16	16	16	17	15	16
Jharkhand	11	8	10	16	10	13
Odisha	10	7	8	11	8	10
Chhattisgarh	10	9	10	13	9	11
Madhya Pradesh	10	8	9	14	9	12
Gujarat	31	26	28	27	19	24
Daman & Diu	59	62	60	60	41	51
Dadra & Nagar Haveli	19	11	16	27	11	20
Maharashtra	32	26	29	31	26	29
Andhra Pradesh	22	17	19	23	19	21
Karnataka	20	20	20	19	19	19
Goa	54	55	55	53	53	53
Lakshadweep	33	57	46	25	49	38
Kerala	71	66	68	59	52	56
Tamil Nadu	38	32	35	34	26	30
Puducherry	39	47	43	40	49	44
A & N Islands	22	20	21	12	11	12
Telangana	16	16	16	21	19	20
Total	19	16	18	22	16	19

Source: Author's calculation from NSSO's Survey of Education 2017-18.

Table 11: Ability to use devices and internet by education of household head in 2017-18

Education of head	Age 6-14 years				Age 15-18 years			
	Can use devices		Can use internet		Can use devices		Can use internet	
	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl
Below primary	5	3	5	3	22	16	29	18
Primary or above	15	13	15	12	49	42	57	46
Total	11	9	11	8	38	31	45	34

Source: Author's calculation from NSSO Survey of Education 2017-18

Table 12: Ability to use devices and internet by type of institute attended by children in 2017-18

Type of school	Age 6-14 years				Age 15-18 years			
	Can use devices		Can use internet		Can use devices		Can use internet	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Government	4	16	4	15	32	63	38	66
Private aided	16	31	14	28	44	78	47	78
Private unaided	10	26	9	25	46	75	51	80
Total	6	24	6	22	37	71	42	74

Source: Author's calculation from NSSO Survey of Education 2017-18

Table 13: Odds ratio from the logit model on the ability to use a computer and the internet

	Able to use computer				Able to use the internet			
	6-14 years		15-18 years		6-14 years		15-18 years	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age	1.62***	1.56***	1.45***	1.36***	1.65***	1.56***	1.50***	1.46***
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Gender: Male								
Female	0.78***	0.82***	0.60***	0.81***	0.72***	0.78***	0.50***	0.69***
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.01)	(0.03)
Education of head: Below primary								
Primary or above	1.70***	2.03***	2.00***	2.32***	1.66***	1.96***	1.89***	2.31***
	(0.08)	(0.10)	(0.06)	(0.10)	(0.08)	(0.10)	(0.06)	(0.10)
Social Group: General								
ST	0.54***	0.43***	0.53***	0.42***	0.59***	0.50***	0.53***	0.42***
	(0.05)	(0.04)	(0.03)	(0.04)	(0.05)	(0.05)	(0.03)	(0.04)
SC	0.58***	0.43***	0.63***	0.44***	0.59***	0.50***	0.66***	0.46***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
OBC	0.74***	0.61***	0.79***	0.58***	0.73***	0.64***	0.80***	0.62***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
Religion: Hindu								
Muslim	0.62***	0.51***	0.57***	0.45***	0.73***	0.53***	0.61***	0.51***
	(0.05)	(0.03)	(0.03)	(0.02)	(0.05)	(0.03)	(0.03)	(0.03)
Christian	1.20	0.98	1.11	1.39**	0.98	0.93	1.03	1.25*
	(0.13)	(0.12)	(0.11)	(0.19)	(0.10)	(0.11)	(0.09)	(0.16)
Others	1.27**	1.31***	1.03	1.15	1.13	1.30***	1.12	1.39**
	(0.15)	(0.13)	(0.09)	(0.14)	(0.13)	(0.13)	(0.10)	(0.19)
Household type rural: Casual labour								
Self-employed	1.54***		1.68***		1.55***		1.74***	
	(0.09)		(0.06)		(0.09)		(0.06)	
Regular wage/ salary	2.40***		2.21***		2.18***		2.15***	
	(0.17)		(0.12)		(0.15)		(0.11)	
Others	2.36***		2.10***		2.06***		1.92***	
	(0.25)		(0.19)		(0.22)		(0.17)	
Household size	1.04***	1.06***	1.01	1.01	1.05***	1.06***	1.00	1.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Rural MPCEQ: Q1								
Q2	1.38***		1.35***		1.35***		1.37***	
	(0.11)		(0.07)		(0.10)		(0.06)	
Q3	2.02***		1.82***		2.06***		1.78***	
	(0.16)		(0.09)		(0.15)		(0.08)	
Q4	3.19***		3.04***		3.30***		3.13***	
	(0.26)		(0.16)		(0.26)		(0.15)	
Household Type Urban: Casual labour								
Self-employed		1.95***		1.95***		1.92***		1.84***

		(0.13)		(0.11)		(0.13)		(0.11)
Regular wage/salary		2.24***		2.04***		2.00***		1.98***
		(0.15)		(0.13)		(0.14)		(0.12)
Others		2.27***		2.28***		1.83***		2.07***
		(0.21)		(0.20)		(0.17)		(0.18)
Urban MPCEQ: Q1								
Q2		1.58***		1.62***		1.65***		1.66***
		(0.08)		(0.08)		(0.09)		(0.08)
Q3		2.34***		2.43***		2.64***		2.64***
		(0.12)		(0.12)		(0.14)		(0.14)
Q4		5.48***		5.13***		5.47***		5.43***
		(0.32)		(0.32)		(0.32)		(0.37)
Constant	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	50,980	26,907	28,891	19,232	50,980	26,907	28,918	19,232
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Author's calculation from NSSO's Survey of Education 2017-18. Robust standard errors are estimated. Level of significance is *** p<0.01, ** p<0.05, * p<0.1

Table 14: Name and code of states used in the figures

State/UT name	code	State/UT name	code	State/UT name	code	State/UT name	code
Andhra Pradesh	28	Himachal Pradesh	02	Mizoram	15	Uttarakhand	05
Arunachal Pradesh	12	Jammu & Kashmir	01	Nagaland	13	Uttar Pradesh	09
Assam	18	Jharkhand	20	Odisha	21	West Bengal	19
Bihar	10	Karnataka	29	Punjab	03	A & N Islands	35
Chhattisgarh	22	Kerala	32	Rajasthan	08	Chandigarh	04
Delhi	07	Madhya Pradesh	23	Sikkim	11	Dadra & Nagar Haveli	26
Goa	30	Maharashtra	27	Tamil Nadu	33	Daman & Diu	25
Gujarat	24	Manipur	14	Telangana	36	Lakshadweep	31
Haryana	06	Meghalaya	17	Tripura	16	Puducherry	34

Source: NSSO 2017-18 Report