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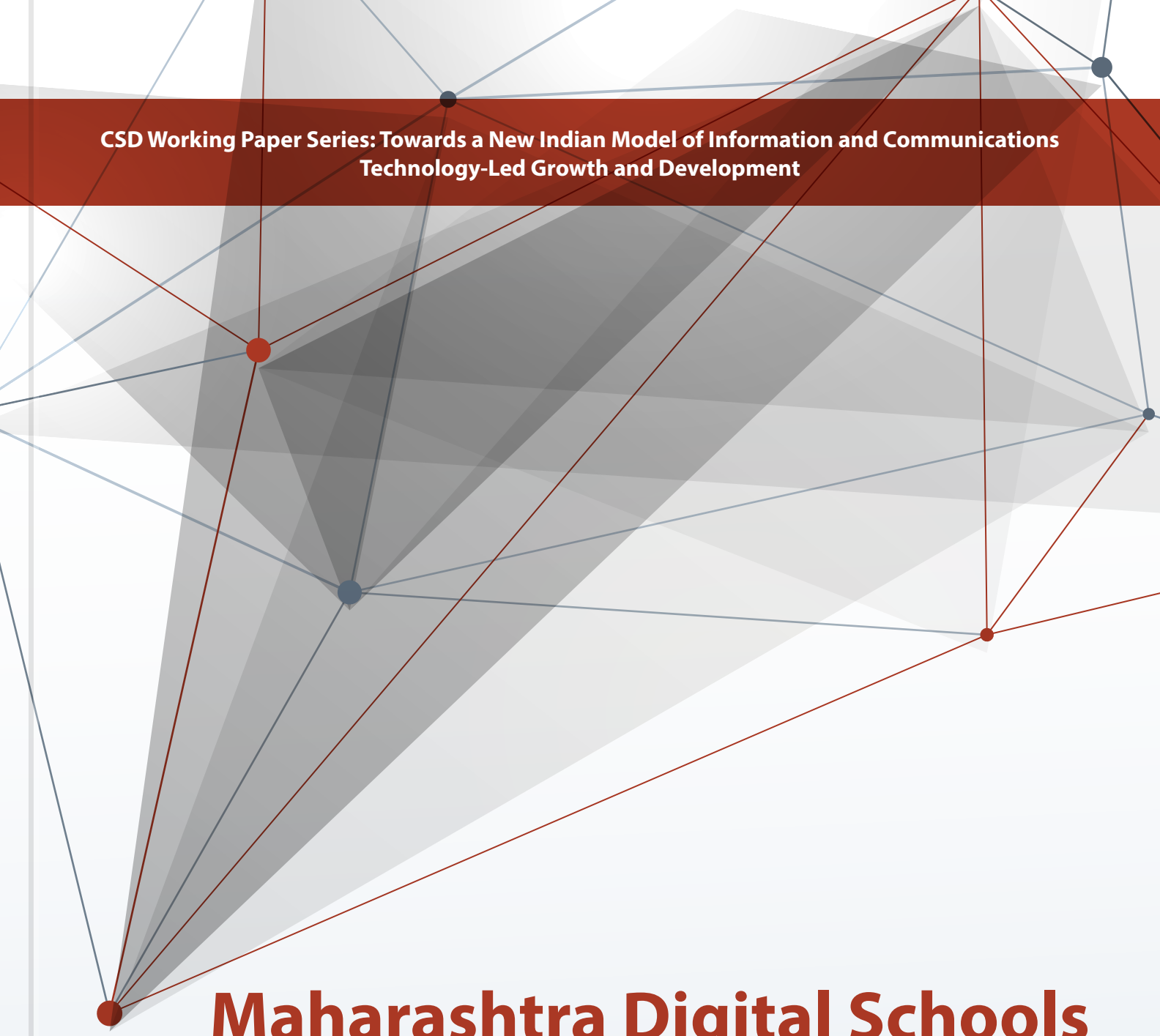

Maharashtra Digital Schools Survey Findings Report

ICT India Working Paper

Tara Stafford Ocansey and *Anchal Sharma*

February 2020

Center for Sustainable Development
EARTH INSTITUTE | COLUMBIA UNIVERSITY

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Acknowledgements

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A special thanks goes to Maharashtra's Education Secretary Dr Vandana Krishna, and Education Commissioner Vishal Solanki for continuously guiding us with their crucial insights.

We cannot thank enough our dedicated leaders at MSCERT, led by Director Dinkar Patil. The Research Department team led by Dr Gitanjali Borude played a critical role in planning and enrolling the survey across 1000 schools in Maharashtra. The survey would not have been possible without the enormous help from the DIECPD heads, the BRPs from each district, and the schools for their valuable contributions and support.

We would also like to extend our warmest gratitude to the visionary team at Leadership for Equity, for their continuous support and contributions throughout the planning and execution phase of the survey.

We are also grateful to the TERI Press team for providing their excellent services in designing the final report.

Executive Summary

Since 2018, the Center for Sustainable Development has been engaged with the Maharashtra State Council of Educational Research and Training (MSCERT) and education-focused NGO Leadership for Equity (LFE) in Maharashtra, in conducting action research to support the state's efforts to strengthen strategies for increasing the quality of education through the integration of Information and Communication Technology (ICT) in schools. This research is part of the project called 'Towards a New Indian Model of ICT-Led Growth and Development', led by Professor Jeffrey Sachs and Dr Nirupam Bajpai. The research aims to assess the role of ICT in various sectors in India, including education, health and agriculture, to better understand the impact of ICT in India's future economic growth and make recommendations for India's continued global leadership in ICT-based development.

Maharashtra has prioritized the integration of technology in teaching practice as a key area for helping to raise learning outcomes for students across the state. In order to guide their investments, the state is interested in identifying the most effective tools and approaches for various types of learning environments within the state that can be scaled up.

This paper presents the findings and proposes next steps from the Digital Schools Survey which was conducted in Maharashtra, with 1000 government schools representing the state's urban/rural/tribal make-up. The Digital Schools Survey was identified as an important step in understanding the current levels of digital infrastructure, support, resources and skills with which schools across Maharashtra are equipped. These findings intend to help inform how the state can best direct its resources to support schools in filling the gaps and optimizing the use of digital technology and resources.

The data findings reveal common scenarios faced by schools across the state, including the reality that most schools are only able to access the Internet due to teachers' willingness to use their own mobile data for educational purposes, and the great reliance on corporate social responsibility for provision of such devices in schools. The data also reveal differences along urban and rural lines. For example, rural schools are likelier to have problems accessing reliable electricity and connectivity, while urban schools are likelier to have an easy access to reliable electricity and connectivity provided by the school authorities, as well as more 'tech-savvy' teachers. The overwhelming preference among teachers for video resources from YouTube and the Digital Infrastructure for Knowledge Sharing (DIKSHA) platform was apparent from the collected data, and it demonstrated the need for more guidance on how to discern quality content from the rest.

Based on the common school scenarios emerging from the data, a set of recommendations is presented for consideration by the Maharashtra State Council of Educational Research and Training (MSCERT). Further, a plan for development of an action research protocol is outlined as the next step for the research team that is being designed to look at a sampling of approaches to pedagogical training for integration of ICT that are intended to meet the specific needs of various school contexts as identified in the Digital Schools Survey.

Introduction

India is using Information and Communication Technologies (ICT) to leapfrog economic development in key sectors such as health, education, infrastructure, finance, agriculture, manufacturing, and governance. ICT is being used to deliver critical goods and services to hundreds of millions of Indian citizens. While many sectors have already seen huge improvements through the innovative use of ICT, such as infrastructure and communications, the education sector has struggled to optimize the potential of ICT for improving teaching and learning. ICT holds an important promise for education, especially in rural areas, if it is optimized and tailored to local needs.

The project 'Towards a New Indian Model of ICT-Led Growth and Development' led by Professor Jeffrey D. Sachs and Dr Nirupam Bajpai looks at the role of ICT in various sectors in India, including education, health, and agriculture to better understand the impact of ICT in India's future economic growth, and make recommendations for the country's continued global leadership in ICT-based development. One of the research strands in the education sector is to better understand what components must be in place to support the effective uptake of ICT among teachers in various educational contexts in Maharashtra.

ICT in Education Research in Maharashtra

Since 2018, the Center for Sustainable Development has been engaged with the Maharashtra State Council of Educational Research and Training (MSCERT) and education-focused NGO Leadership for Equity (LFE) in Maharashtra, in conducting action research to support the state's efforts to strengthen strategies for increasing the quality of education through integration of ICT in schools.

Maharashtra has prioritized the integration of technology in teaching practice as a key area for improving learning outcomes for students across the state. In order to guide their investments, the state is interested in identifying the most effective tools and approaches for various types of learning environments that can be further scaled up in the state. The research focus initially looked specifically at the rollout of the DIKSHA (Digital Infrastructure for Knowledge Sharing) platform, and upon finding that some of the barriers to an effective uptake of the platform were similar to those hindering teachers from adopting ICT more broadly, the research team expanded the scope to look more holistically at how support and training for teachers and content creators can help facilitate development and use of more locally relevant content both on the DIKSHA platform and beyond for teachers across Maharashtra.

This education research requires looking at different models of conducting teacher training in integration of ICT for more interactive, learner-centred classroom practice. This will contribute to improved understanding of what approaches could work best for the diverse contexts within Maharashtra, in alignment with the state's strong commitment to identify effective, scalable solutions for equipping the state's massive population of teachers with these skills. The primary focus in the project will be to conduct action research to identify what methods and models of pedagogical training and support for integrating ICT effectively in classrooms lead to a sustained uptake among teachers in different settings.

Digital Schools Survey

As a first step in informing the design of training approaches for various contexts and school needs in Maharashtra, the research team carried out a Digital Schools Survey at the beginning of the 2019–2020 academic year. The goal was to understand the current levels of digital infrastructure, support, resources, and skills that schools across Maharashtra are equipped with to further inform how the state can best direct its resources to support schools in filling the gaps and optimizing the use of digital technology and resources. The survey looks at six major components:

1. General School Characteristics
2. School Support
3. Digital Infrastructure
4. Teacher ICT Integration
5. Digital Content Availability
6. Digital Community Engagement

Data from the survey were analyzed to create a holistic picture of schools' capacity to fully leverage the advantages

of digital technology to improve the methods of teaching and learning. Some of the key questions that guided the data analysis include:

» What are the common school scenarios in terms of school capacity for effectively integrating ICT into teaching and learning, considering the components listed previously?

» Are there common trends in terms of school capacity for integrating ICT for effective teaching and learning across urban, rural, and tribal schools? If so, what are they, and how do they differ from each other?

» What do teachers see to be the greatest needs to support their improved teaching practice with regard to ICT?

» How are current ICT investments being made in schools?

Data Collection Protocol and Preparation

The survey was carried out in 1000 schools in Maharashtra through a mix of online and in-person means. The online survey, which was conducted both in Marathi and English, was distributed using Survey Monkey (an online cloud-based software for survey development and dissemination). The research team assumed that many of the most hard-to-reach and less digitally equipped schools that this survey was designed to support would be the same ones who could struggle to complete an online survey. Therefore, for the data collected through this survey to have the intended impact, Block Resource Persons (BRPs) played a critical role in collecting in-person survey data at schools identified as being 'hard-to-reach' or those which lack the ability to easily complete an online survey.

Sampling

Maharashtra has a total of 66,750 government schools, with about 91.3% classified as rural and 8.7% as urban, respectively. Less than 1% of these schools are sub-classified as tribal. The 1000 government schools that participated in the survey were selected to represent the state's urban/rural/tribal make-up, spread across regions. Amongst the 1000 sampled schools, 912 were classified as rural, 77 as urban, and 11 as tribal, consecutively.

Method

For the preparation of data collection, members of the research team coordinated with MSCERT's Head of Research Department to design and carry out webinar-based training sessions for all the heads of Maharashtra's District Institute of Education and Continuous Professional Development (DIECPD) offices, as well as with the selected BRPs from each district who would be tasked with carrying out the survey. It was notable that these were the first-ever webinars that the Research Department of MSCERT conducted through an ICT-enabled, distance training program.

During these webinars, the DIECPD heads and BRPs were informed of the larger 'Towards a New Indian Model of ICT-Led Growth and Development' research agenda that the Digital Schools Survey is a part of, the objectives of the survey, and the plans for how findings would be used to inform action research to support teachers from various school environments to improve their skills through training in integration of ICT in teaching practice.

BRPs were expected to visit all of their selected schools within the allotted time frame. During each visit, the first step was to introduce the purpose of the survey to the school heads before proceeding with the survey. BRPs were trained to emphasize on the following points:

» The purpose of the survey is to better understand the needs of the schools based on their specific circumstances, so their truthful answers are critical.

» The survey is for all *schools*, not just those that already have devices or are using ICT in their classrooms. The idea is to help design ICT solutions for schools based on their needs and constraints.

» The person to complete the survey should be the person with the best knowledge of the school's ICT resources, use of ICT in lesson preparation and/or classroom, and/or readiness factors for future use of ICT in the school. This person might be the school head, ICT teacher, or another tech-savvy or an interested teacher. Ask the school head to identify who the best person to complete the survey would be.

» Ask the school head if he/she has any questions and do your best to answer them. If there are any questions, ask them to direct their questions to the research department.

» Inform the schools to not to fill the online version of the same form in future.

Timeline

» 5–17 August 2019: BRPs visit target schools to introduce the purpose of the survey, answer any questions, and complete the survey

» 17 August–30 September 2019: Remaining schools complete the online survey

» 1 October–31 December 2019: Data analysis

» January 2020: Report writing

Limitations

The survey was planned for all the 36 districts of Maharashtra but due to heavy rains during the data collection period of August–September, the Block Resource Persons (BRPs) were unable to make enough school visits in two districts – Mumbai City District and Mumbai Suburban District – to collect adequate data. The final data collection was done from 34 districts covering the original sample size. It is possible that urban schools are underrepresented in the total number of schools since Mumbai, the state's most urban district, was not included in the sample.

Among the 1000 schools from which data were collected, 912 are classified as rural schools, 77 as urban, and 11 as tribal, respectively. Therefore, the sample for urban and especially tribal schools is quite low. In some cases, tribal schools were not included in the disaggregated analysis because the sample was considered to be too small to yield meaningful interpretation. In other cases, where there was some anomalous factor, it was included in the disaggregated analysis.

Findings

General School Characteristics

With regard to general school characteristics, among the schools from which data were collected, 46% were primary schools, 49% were middle schools, and 5% were secondary schools (see Figure 1). In both rural and urban schools, the female-to-male ratio was about 49 to 51, with slightly more boys enrolled than girls. In tribal schools, however, girls were significantly likelier to be enrolled than boys, with a female-to-male ratio of about 52 to 48 (see Table 1). While further research would need to be done to better understand the reasons, one hypothesis might be that in tribal areas, young boys are likelier to be expected to perform agriculture-related or other labor.

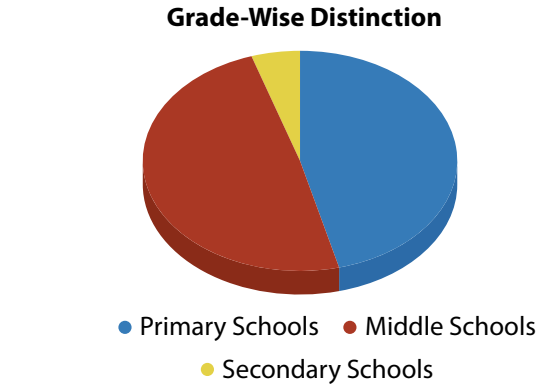

Figure 1

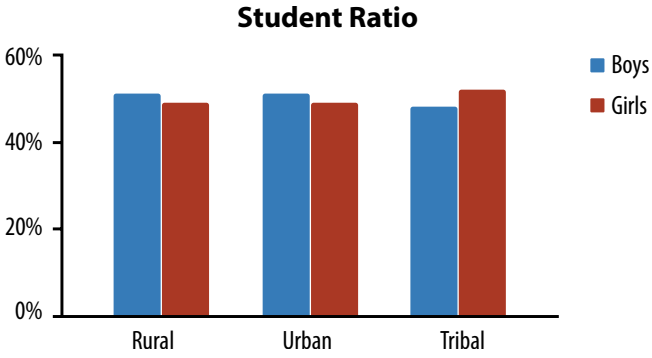

Table 1

The survey also found that teachers are likelier to be men than women across settings, with the gender gap least significant in rural areas (55% male, 45% female) and most significant in tribal areas (62% male, 38% female) (see Table 2).

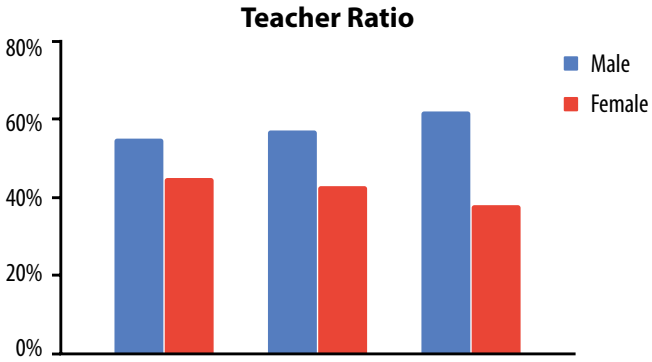

Table 2

A majority of both urban and rural schools reported that most children travel 1 km or less to reach their school, while 18% of tribal schools reported that some children travel over 5 km to reach their school (see Table 3).

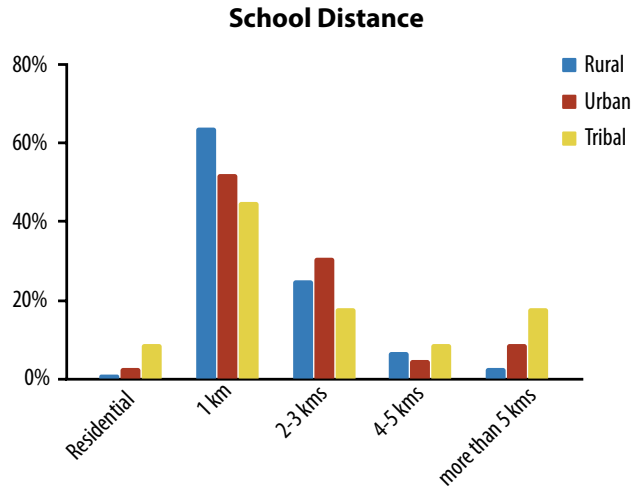

Table 3

Among the surveyed schools, 93.5% have access to electricity, with the majority of them getting their electricity from the grid. There were not significant differences between urban and rural schools in terms of their sources of electricity. About 9% of schools reported having dysfunctional meters (see Table 4).

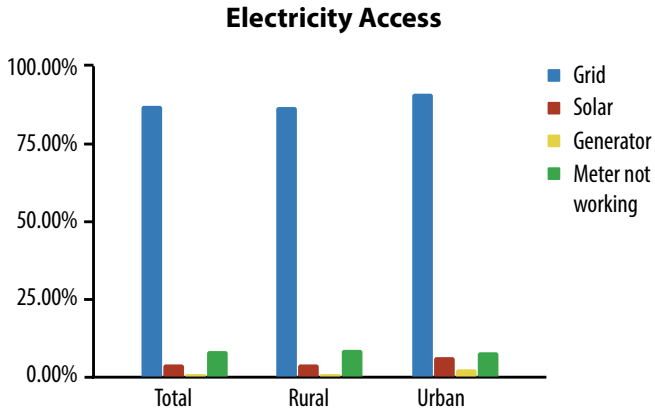

Table 4

School Support and Training

When asked whether their schools received regular support from DIECPD, 4.3% of respondents said that they did not. However, when asked about the frequency of visits, 20.3% reported that they receive visits from DIECPD rarely or never.

When mapping schools that reported receiving no visits from DIECPD, it was clear that the schools are clustered in particular areas, especially in Amaravati Division (see Figure 2).

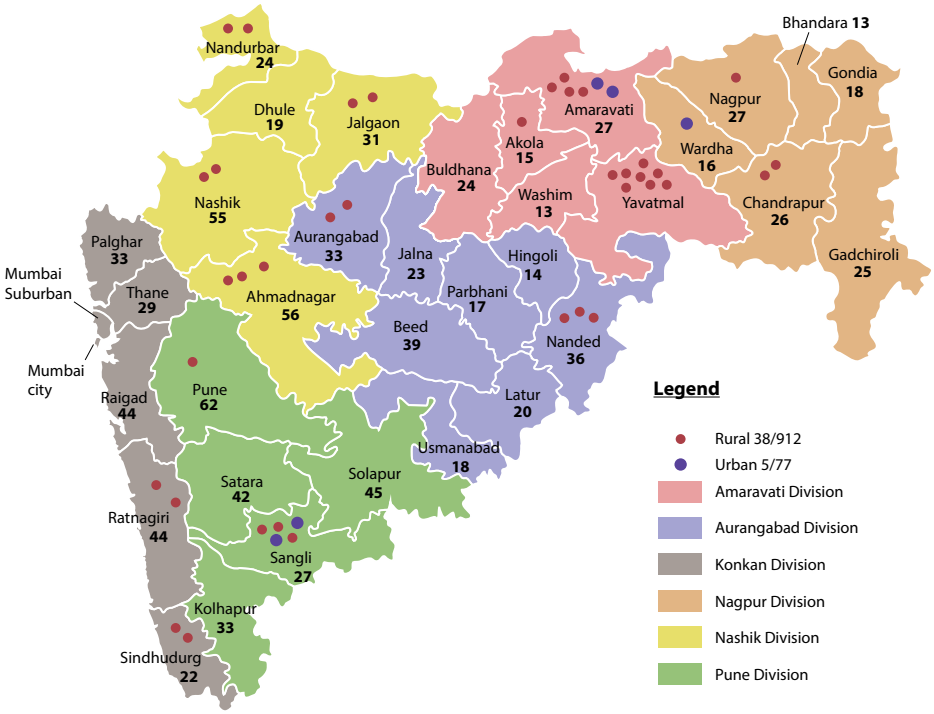

Figure 2

Among all schools, 65.4% reported having received training on the integration of ICT from their DIECPD in the past year, while 34.6% reported not having any DIECPD trainings. Within this average, tribal schools had the least access to DIECPD trainings, with 54.5% reported to not have any DIECPD trainings, followed by 40.3% of urban schools, and 33.9% of rural schools. Among the 65.4% who reported having received DIECPD trainings, 18.5% reported receiving 1 training in the past year, 24.2% received 2 trainings, and 22.5% received 3 or more trainings (see Table 5). This trend shows that where investments are made in providing training on integration of ICT, DIECPD trainings are likelier to be provided on an ongoing basis rather than as a one-off event.

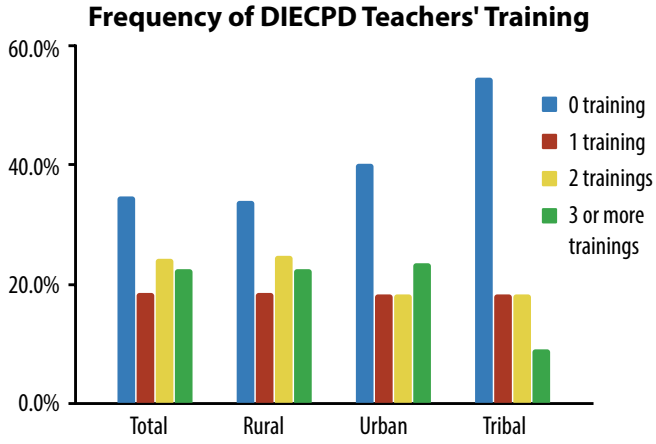

Table 5

Out of the total schools, 42.6% reported being very satisfied with the DIECPD support, 21.5% were somewhat satisfied, 21.8% were somewhat dissatisfied, and 13.7% were very dissatisfied (see Table 6).

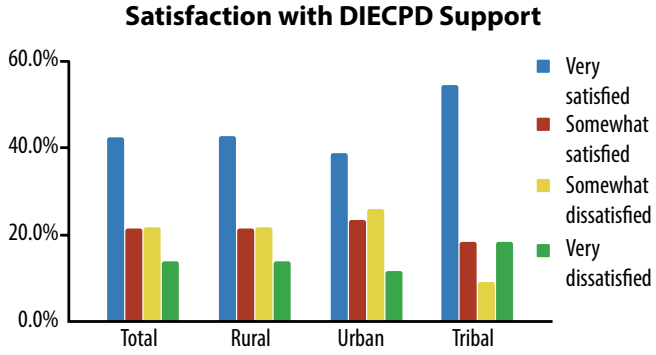

Table 6

A greater percentage of schools reported having teachers who have participated in 'tech-savvy' teacher trainings, which may include the DIECPD trainings already reported, and/or provided by non-governmental or other private partners, with a total of 80.3% of schools reported to have received at least one tech-savvy teacher training. However, while a greater percentage of schools have received at least one tech-savvy training regardless of a provider than those who have received training from DIECPD, tech-savvy trainings appear to more frequently be conducted as one-off events, as there is a sharp drop between schools that reported to have received 1 training and those who received 2 trainings (47.1% to 25.2%). The drop is again significant from those reported to have received 2 trainings and those receiving 3 (25.2% to 8%) trainings, respectively (see Table 7).

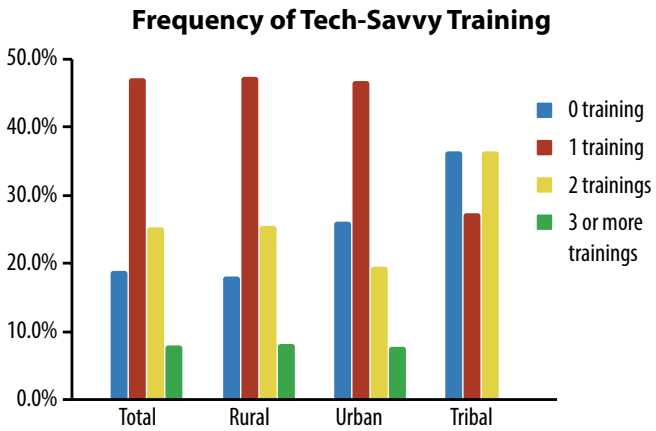

Table 7

The exception to this trend is the tribal schools, which are the only subset to have a greater number of schools reported to have received two trainings than having received only one. When comparing against the data on DIECPD trainings, and based on the assumption that this broader question likely includes some of the DIECPD trainings, it could be inferred that tech-savvy trainings provided by partners other than DIECPD are significantly likelier to be conducted as one-off events.

In regard to the focus of tech-savvy trainings received, the largest proportion of schools reported to have received training focused on using ICT in the teaching and

learning process (59%), with another 40% receiving basic introductory training on using ICT (see Table 8).

Trends for the aforementioned data across primary, middle, and high school levels were similar.

Focus of Tech-Savvy Training

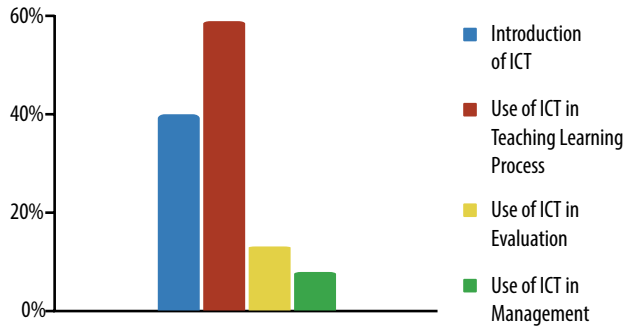

Table 8

connecting to Internet with a dongle, 3.6% use Wi-Fi, and 2.7% use broadband, while 87.4% reported connecting using mobile data (see Table 9).

Schools' Access to Connectivity

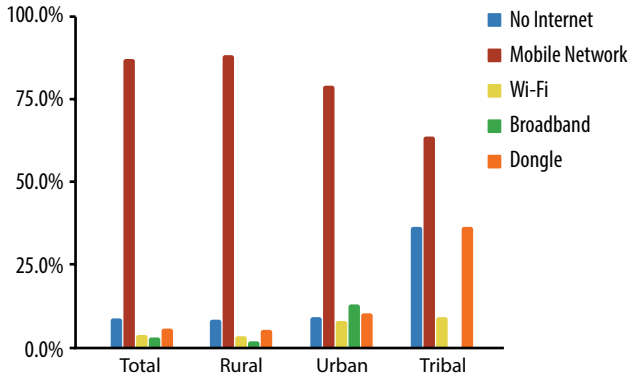

Table 9

School ICT Infrastructure

A vast majority of schools at 91.2% reported having an Internet facility, but dig a little deeper, and the data reveal that among this group of schools, 5.4% reported

Nearly 9% schools don't have access to any kind of Internet connectivity. The mapping of these schools shows that these schools are clustered in a few districts which are notably in Konkan, Ahmadnagar, and Aurangabad divisions (see Figure 3).

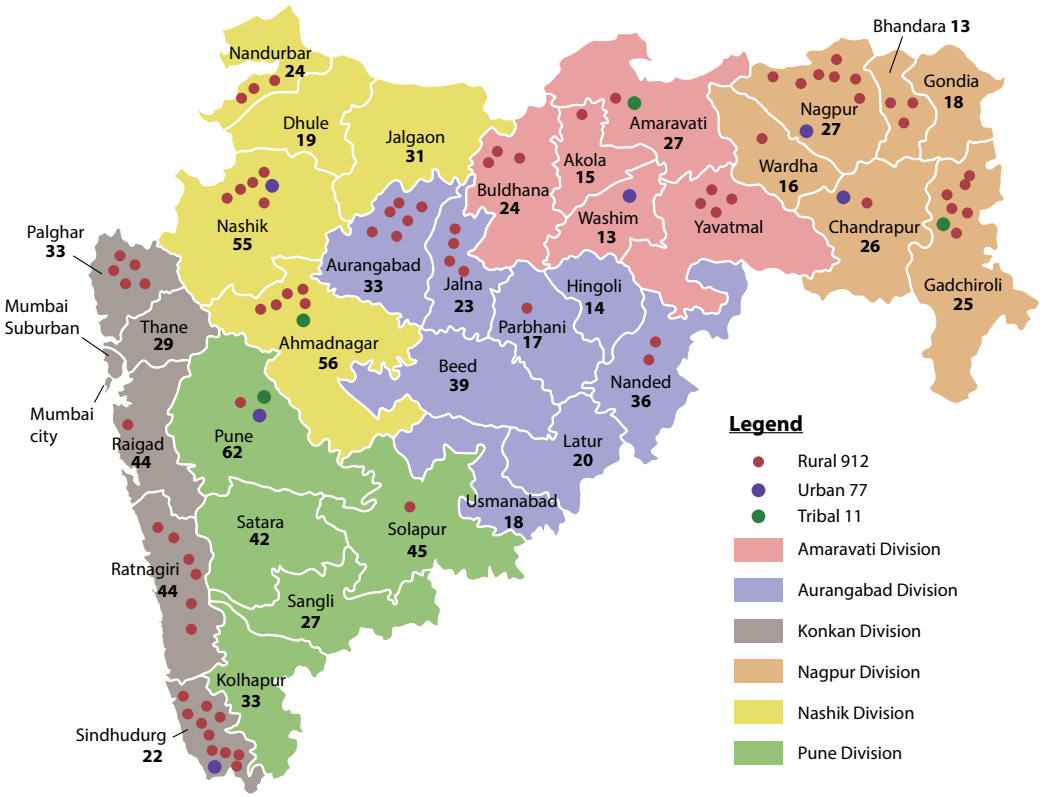

Figure 3

When asked about common connectivity access scenarios in schools, a majority (88.2%) of schools reported that their teachers connect using their own mobile data via their phones. However, it is notable that urban schools reported stronger, more stable connectivity than rural schools, with 4.3% of urban schools reporting connectivity that is 'mostly reliable' and that they are able to connect to only a few devices at a given time, as compared to only 2.6% of rural schools, and 10% urban schools having a reliable connectivity to connect numerous devices simultaneously as compared to 2% of rural schools. Tribal schools are most likely to have teachers' mobile data as their only connectivity option (see Table 10).

Schools' Internet Connectivity Scenarios

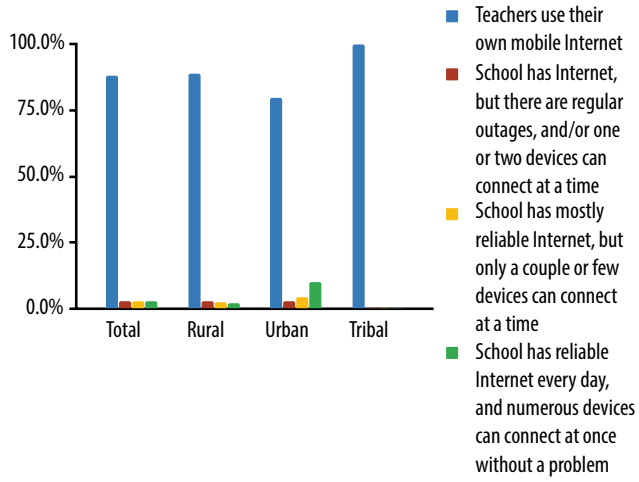

Table 10

When it comes to devices, desktop computers are the most significantly available type of device, with 78% of schools reported to have at least one desktop computer. Projectors are also common, with 61% of schools reported to have at least one. Across all schools, 17% reported using tablets, while 10% reported using laptops; however, the data show that laptops are more prevalent in urban schools, with 16% of urban schools having at least one laptop as compared to 10% of rural schools, while tablets are three times more common in rural schools than urban, with 17% of rural schools having at least one tablet as compared to just 5% of urban schools.

Rural schools are also likelier to have LED or Smart TVs. The reasons for these differences warrant further research, but seem on the surface to align to the different needs and capacities of typical urban and rural schools. Urban schools have more consistent access to electricity and so can support more powerful devices like laptops, while rural schools need less energy-demanding devices such as tablets and devices that can serve a greater number of students such as LED and Smart TVs. It is important to note that, while prevalence of desktop computers is significant, it was also reported that over 27% of desktop computers in schools are *not* in working condition (see Table 11).

% of Schools with Various ICT Devices

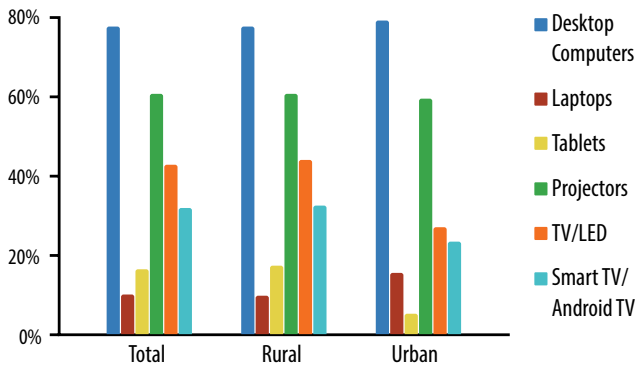

Table 11

Looking at the schools having ICT devices, it is clear that a significant portion of such devices are made available to schools through corporate social responsibility (CSR) contributions. Among the total schools having ICT devices, as shown in Table 11, in cases of the most commonly used devices, about 50% of schools received these devices through CSR initiatives (see Table 12).

% of Schools Having ICT Devices through CSR

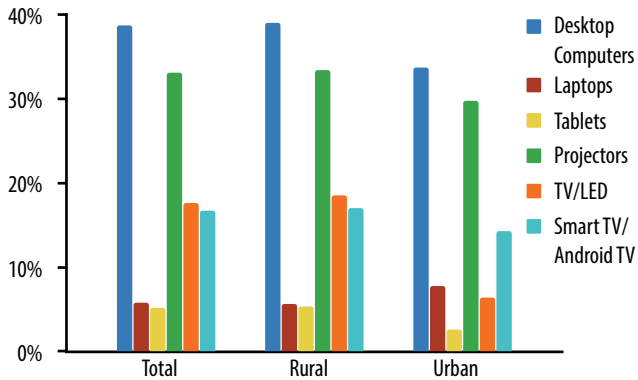

Table 12

Delving deeper, among those schools reported to have various types of devices, the average number of each device type is shown in Table 13, and as evident, is quite low across the board. Urban schools with desktop computers have an average of 7 (devices) per school, as

compared to just 3 (devices) per rural school. Rural schools are again better equipped with tablets, with an average of 4 per school, as compared to just 1 per urban school.

Average # of Devices per School

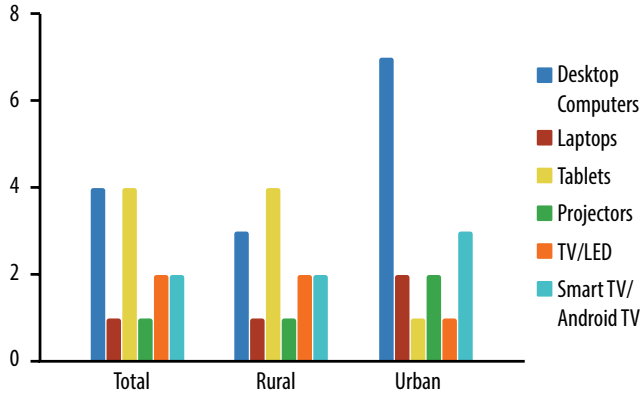

Table 13

Teacher Practice and Integration of ICT

Overall, 81.5% of schools reported having teachers who use ICT to prepare lessons, with 83.3% of schools having teachers using ICT to deliver the classroom lessons. About 74.8% reported teachers using ICT at least once per week. Trends were similar across urban, rural, and tribal schools (see Table 14).

% of Schools Where Teachers are Using Technology to Prepare and Deliver Lessons

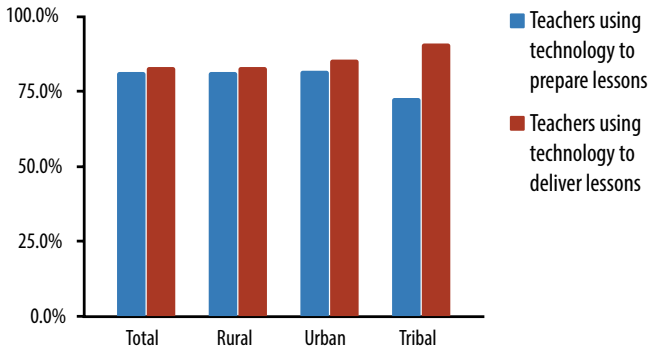

Table 14

With regard to teachers' exposure to ICT integration training opportunities, and their apparent impact on teacher use of ICT in preparation and delivery of lessons, the data show notable differences in impacts of different types of training, and in rural versus urban school settings. For teacher trainings provided by DIECPD, while findings among urban schools were mixed, findings from rural schools show a clear upward trend in teacher integration of ICT for both the preparation and delivery of lessons with respect to more training opportunities available for teachers from DIECPD. About 76.1% of teachers receiving zero trainings reported using ICT to prepare lessons, while 87.9% of teachers receiving 3 or more trainings reported the same (see Tables 15 and 16).

% of Schools Integrating ICT in Lesson Preparation, According to Training Received from DIECPD

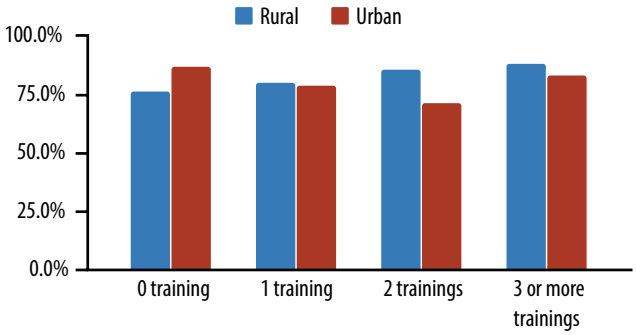

Table 15

% of Schools Integrating ICT in Lesson Delivery, According to Training Received from DIECPD

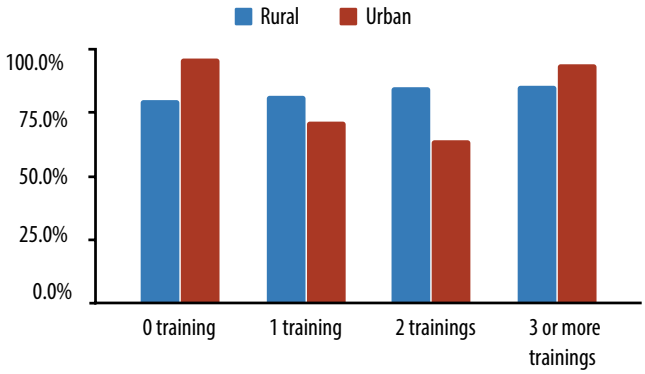

Table 16

For the broader question concerning schools' access to 'tech-savvy' teacher trainings, including those provided by DIECPD as well as by non-governmental or other private partners, the impact on teacher use of ICT in preparation and delivery of lessons is more significant, and, for most part, applies to both urban and rural schools. Among schools receiving nil tech-savvy trainings, 66.1% of rural

schools and 80% of urban schools reported having teachers using ICT to prepare lessons. These figures climb significantly to 95.9% and 100%, respectively, for teachers who have received 3 or more tech-savvy trainings (see Tables 17 and 18). These findings suggest that tech-savvy trainings provided by non-governmental or other private partners could be more impactful on teacher practice than DIECPD trainings, particularly for urban schools, but that DIECPD trainings are also effective, especially for rural schools.

% of Schools Integrating ICT in Lesson Preparation, According to Tech-Savvy Training Received

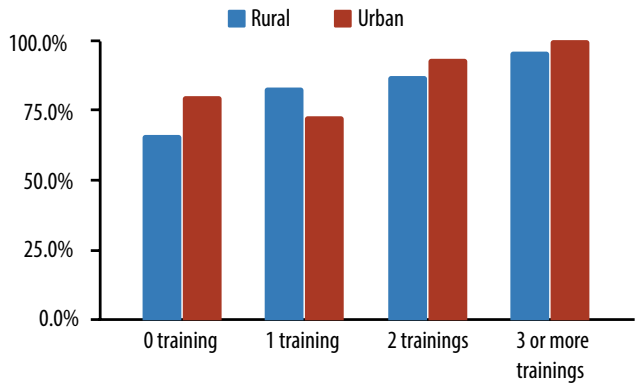

Table 17

% of Schools Integrating ICT in Lesson Delivery, According to Tech-Savvy Training Received

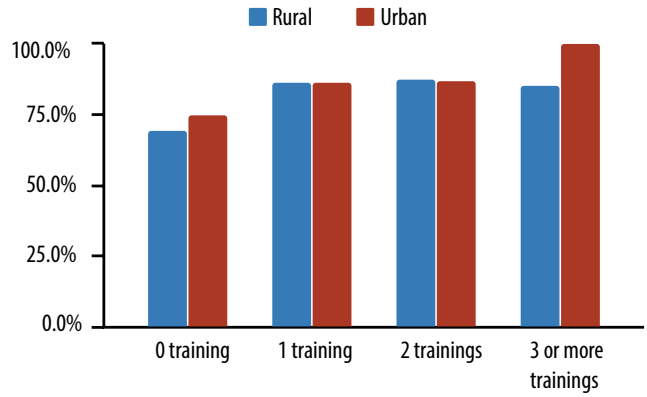

Table 18

When asked about the most common pedagogical techniques used in their schools, 82.6% of schools reported teachers using 'Constructivism', 80.8% reported using 'Pair/Group work', and 65.2% reported using 'Discussion method'. No other method was chosen by more than 50% of schools, though 'Student demonstration method' came close with 49.6% of schools selecting that option. A follow-up research to further investigate how teachers define constructivism could be helpful in guiding how training on ICT integration can highlight the way ICT enhances facilitation of learning using teachers' preferred methods (see Table 19).

Teachers' Preferred Pedagogical Techniques

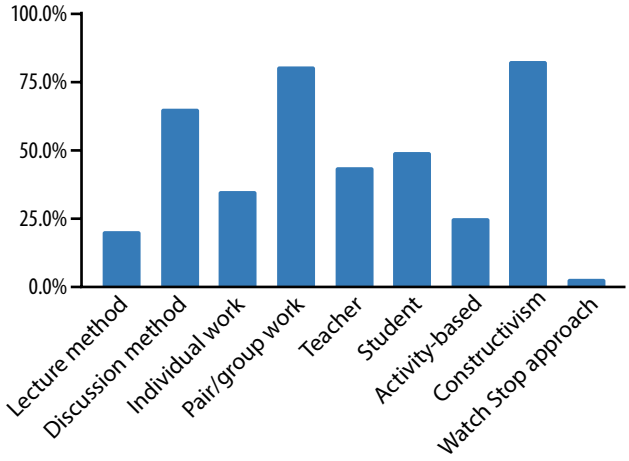

Table 19

Schools' Preferences for Digital Content

When asked about the types of digital resources most frequently used by teachers, 95.5% of schools reported 'videos' as the most frequently used resource. Audio resources were also popular, reported by 74.9% of schools, as were PowerPoint presentations, reported by 44.6% of schools (see Table 20).

Teachers' Most Used Digital Resources in Teaching Process

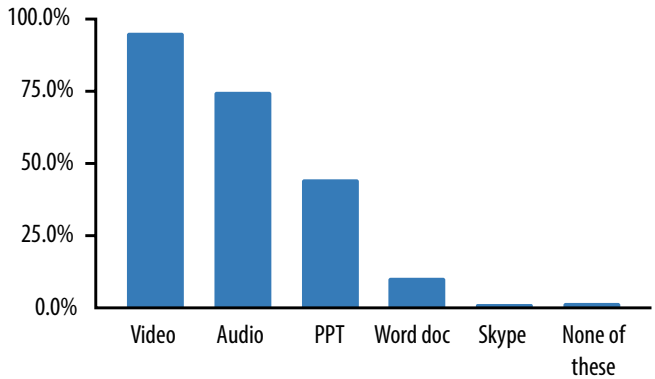

Table 20

Teachers' preference for teaching with videos is further demonstrated by the finding that YouTube is the favorite digital platform among teachers from 78.6% of schools, followed closely by DIKSHA at 75.2%. No other platforms came close, though eBalBharati (18.5%), teachers' self-made e-content (16.8%), and Kompkin (13.3%) were all selected by significant number of schools. About 2.8% of schools reported that they do not use any digital content (see Table 21).

Teachers' Preferred Digital Content Platforms

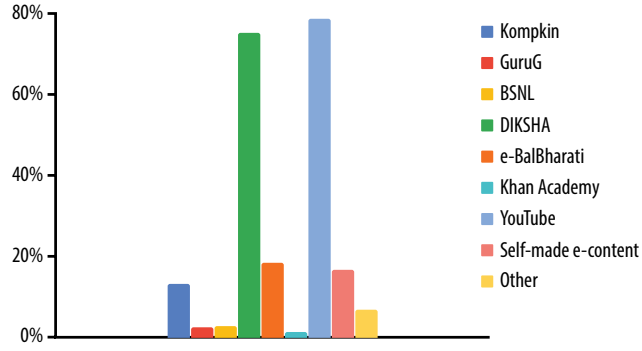

Table 21

Schools were also asked about teachers' expectations from digital content availability. By far, the most commonly captured expectation, selected by 77% of schools, was that digital content be made available by grade/class. Practical resources such as examination papers and worksheets were also selected by 53% schools. Interestingly, urban schools (53%) were likelier than rural schools (46%) to expect digital content to be made available in their mother tongue, while rural schools (39%) were likelier than urban schools (32%) to expect digital content in English (see Table 22).

Teachers' Expectations for Digital Content

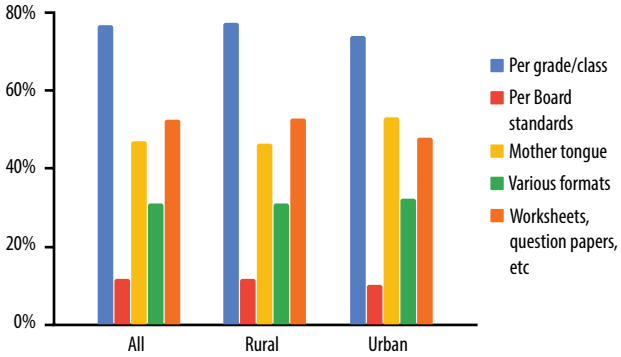

Table 22

Digital Engagement with Parents and Community

It is clear that the most common methods for engaging with parents and community about school-related matters involve face-to-face interactions, with in-person meetings being selected as the primary method in 90.7% of schools. While digital communications were less commonly cited, it is clear that WhatsApp is the preferred medium for digital communication between schools and parents, with 35.8% of schools use WhatsApp to communicate with parents and community members (see Table 23).

Schools' Engagement with Parents/Community

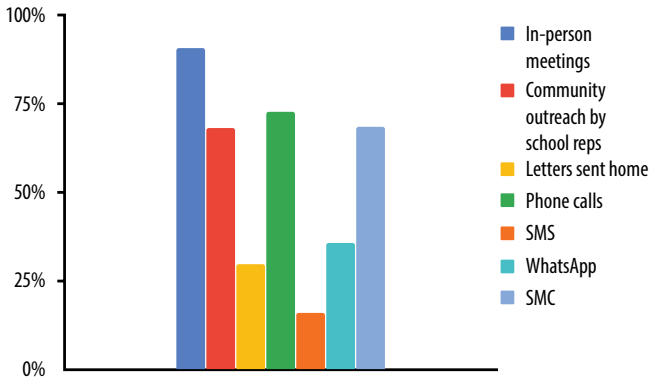

Table 23

While many schools reported regular use of ICT by teachers in preparing and delivering their lessons, schools as a whole appear to take a less proactive role in building their own web presence. About half of the schools reported taking advantage of the free default website provided to each school by the government, while more than one-third of the schools reported having no online presence at all, with rural schools less likely to be online than their urban counterparts. Urban schools are 61% likelier than rural schools to have a social media account and 58% likelier to have at least 1 teacher with their own content channel (see Table 24).

Schools' Digital Presence

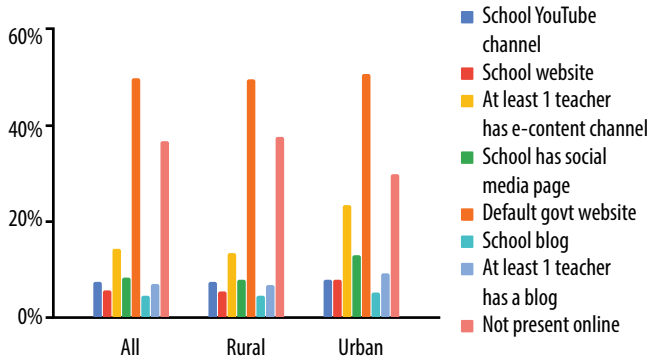

Table 24

Discussion

This data analysis is intended to offer a bird's-eye view of the current state of school capacity for and practice of integrating ICT in Maharashtra's schools. One overarching trend is that progress made by schools to increase their use of ICT in teaching practices seems to largely be a result of teachers' own efforts in using their own mobile devices to access the Internet. It is also evident that at least half of the schools equipped with ICT devices have them due to corporate social responsibility efforts, and therefore, there is little consistency across schools in terms of types and number of devices they have. This poses significant challenges to government agencies and other organizations seeking to provide training to teachers in integration of ICT that is relevant to the types of devices and connectivity they have an access to.

There is evidence that training in integration of ICT, whether provided by DIECPD, non-governmental or private partners, is likely to have an impact on increasing teachers' use of ICT in preparation and delivery of lessons. Trainings provided by non-governmental partners appear to have a greater and more consistent impact on teachers' uptake of ICT across rural and urban schools than DIECPD trainings. This could be due to the fact that many trainings provided by non-governmental or private partners are focused on specific software platforms or other specific ICT solutions new to the schools, and therefore, will be likelier to impact the uptake of that particular platform or solution. DIECPD trainings, on the other hand, are more often focused on how teachers can take greater advantage of resources they already have.

There also appear to be clear trends among urban versus rural schools with reference to the types of resources they have access to. For example, a common scenario found in 9% of rural schools is the problem of a broken meter, which may make access to electricity unreliable and/or weak in its strength to power up ICT devices. Rural schools are also less likely to have access to connectivity provided by their school, with most relying on their own mobile devices for Internet connectivity. Even across schools reporting access to connectivity, urban schools reported being likelier to have reliable, stable connectivity, while rural schools are more prone to struggle with less reliable connectivity that is only strong enough to power up a few devices at a given time.

Common scenarios in urban schools include greater access to connectivity provided via Wi-Fi or broadband by the school. Teachers in urban schools are also likelier to be tech-savvy, with greater proportions of schools reported to have teachers with their own YouTube channels, or schools with their own social media accounts.

Recommendations

Public/private coordination to ensure basic package of resources tailored for specific school settings:

The data reveal unique challenges for urban schools versus rural schools, as well as challenges shared across school settings. At the same time, the data show a greater dependence on CSR efforts for provision of devices in schools, and a wider breadth of types of devices being provided. The government can play a role in recommending ideal ICT packages for schools in various common school scenarios. For example, rural schools with unreliable electricity and weak connectivity could be best suited to using a Smart TV with a dongle and a set of student tablets that can be charged using solar power, all pre-populated with curriculum-aligned multimedia content. Urban schools, being likelier to have reliable electricity and tech-savvy teachers with their own smartphones, could benefit from an investment in either Wi-Fi or Broadband connectivity to enable greater leverage of teachers' own devices without expecting them to pay for their own data costs when using their phones for teaching purposes.

Incentivize equitable investment by IT industry to enable stronger, more stable access to connectivity in rural and tribal schools:

The findings show that rural and tribal schools are less likely to have Internet connectivity provided by their schools, and are also less likely, even when using their own mobile data, to have a strong enough service to connect more than a very small number of devices at a time. One reason for this inequity in quality of connectivity could be that IT companies are not incentivized to invest in the necessary infrastructure in rural and tribal areas where populations are smaller and sparser. The government may be able to play a greater role in incentivizing the private sector to maintain the necessary infrastructure to ensure that all schools have equitable access to strong and reliable connectivity.

Increase teachers' access to ongoing professional development through blended delivery models:

The findings demonstrate the positive impact that sustained access to professional development opportunities can have on teachers' uptake of ICT for their lesson preparation and delivery. For 'tech-savvy' trainings, there is a clear correlation between increased number of teacher trainings and increased integration of ICT by teachers across both urban and rural schools. DIECPD trainings alone showed a less significant correlation among rural schools, with mixed results for urban schools. Further research into the different approaches taken by these various types of teacher training programs could help contribute greater understanding into the key training inputs and approaches that lead to most significant and sustained teacher uptake of ICT, and the ways in which teachers use ICT after receiving necessary training. The government can further use these findings to inform non-governmental and/or private partners to work toward delivering training to teachers in various common school scenarios, and/or adopt more impactful inputs and approaches for trainings by DIECPD.

Improved guidance from government on 'Content Quality Guidelines':

It is clear from the data that the majority of teachers turn to YouTube for their content. While YouTube has a wealth of quality resources for teachers, there is also a lot of low-quality content, and it could get difficult at times for teachers to know how to parse out the best from the lackluster. Clearer content quality standards and dissemination of those standards to teachers can help them select suitable content. The government might also consider creating and continually updating a set of recommended YouTube channels. This could also create an opportunity to promote and incentivize the instrumental work of Maharashtrians and other Indian teachers with their own high-quality YouTube channels.

Next Steps

Based on the survey findings, an action research protocol is being designed to look at a sampling of approaches to pedagogical training for integration of ICT that are intended to meet the specific needs of various school contexts as identified in the Digital Schools Survey. The models for teacher training will be selected among existing innovative approaches being led by NGOs and/or DIECPDs, as well as at least one model to be designed by the research team in collaboration with Leadership for Equity and DIECPDs. Selected schools will receive at least 2–3 in-person/blended trainings over the course of the academic year, and have an access to staff for regular support using WhatsApp and other video conferencing technologies. The research questions that this action research seeks to answer include:

- What are the different kinds of teacher-training initiatives focused on pedagogy for ICT integration that are being conducted by DIECPDs and other education stakeholders (e.g. NGOs), and how do their approaches align/differ?
- Which training approaches (in terms of format, frequency, follow-up, etc.) lead to most effective/sustained teachers' uptake and changes in students' participation?

Different models of teacher training will be studied, and identified for further study during the next academic year through outreach to various DIECPDs and NGO partners engaged in innovative work in the area of teacher training. For example, the Aurangabad DIECPD has been conducting teacher support calls using Zoom (web-based video conferencing tool) in order to reach remote schools. The company Jnana Probodhini has been developing e-content for 11 years, and over the past year, it has been developing content for the DIKSHA platform. Their offering includes providing content and skill-based trainings for teachers while customizing their training methods to the needs of the schools they work with. They are currently developing an app to further support teachers with content and training tips, and planning to conduct their own internal research to develop a blended learning model for teacher training. These different approaches are likely to be among those selected for this action research and comparative analysis.

For the model to be developed by the research team, the team is looking at developing an adapted version of the Center for Sustainable Development's Virtual Reality Teacher Training Platform. The Virtual Reality (VR) platform was developed in 2017 by CSD's 'Connect to Learn' initiative – a partnership with global telecommunications company Ericsson. Platform development was supported by Qualcomm Wireless Reach, and was designed as a follow-up to a 2-year engagement with 31 schools in Myanmar supported by UK Aid's Girls' Education Challenge. During the two-year program, 31 schools in Myanmar received installations of teacher-computer kits and student tablets, and were equipped with an Internet connectivity as well. Teacher trainers from the Myanmar Ministry of Education received training in integration of ICT into classroom practice, which they then implemented with teachers from the participating schools. The project saw significant uptake in the use of technology by teachers and students. To sustain that progress, the initiative needed to identify a low-cost approach to ensure teachers would have an ongoing access to both training and support.

CSD and Ericsson, together with a UK-based VR firm, developed a series of four modules to help 1000-plus teachers understand the goals of student-centered, ICT-integrated pedagogy, and explore various approaches to integrating them in the classroom. The approaches and sample activities that are covered in the modules are based on a global literature review of recommended pedagogical practices from country curricula in order to ensure that the activities are applicable for different country contexts.

Based on expressed interest in this solution as a possible area for further exploration in Maharashtra by the Maharashtra Education Commissioner, the research team is looking into possibilities for adapting their solutions for the Maharashtrian context in partnership with SCERT and LFE, and piloting it as part of this research strand looking at different approaches to teacher training focused on the integration of ICT.

Alongside implementation of these various training approaches, the research team will conduct teacher and student surveys, and interviews and regular classroom observations to monitor the degree to which involvement in teacher training correlates with an increased use of technology in lesson preparation and/or delivery and modes of student participation. Classroom observations will measure the students' engagement taking place in the classrooms, how much time is spent on various types of activities, and the different ways ICT is used by both teachers and students.

After the completion of this research in evaluating different models of teacher professional development, a comparative analysis will be conducted to help understand which aspects of teacher training can lead to the most significant changes in teacher practice and classroom engagement, considering cost effectiveness of the various approaches as well. Based on this analysis, a set of recommendations will be made to analyze how effectively teacher training in integration of ICT can be scaled up.

Appendix – Digital Schools Survey: Questions

Background Questions

1. District (drop-down)
2. Block
3. Name of the School
4. UDISE Code
5. School Management Type
    a. Zila Parishad
    b. MNC
    c. NP
    d. Tribal Welfare Department
    e. Social Welfare Department
6. What is the medium of instruction in your school?
    a. Marathi
    b. Hindi
    c. Urdu
    d. English
    e. Other _____

General School Characteristics

7. What grades does your school serve?
8. How many students are enrolled in your school?
    a. Boys_____
    b. Girls_____
9. How many teachers work in your school?
    a. Men_____
    b. Women____
10. How many classrooms does your school have?
11. Does your school have electricity?
    a. Yes
    b. No
        i. If 'Yes', how is it supplied?
            1. Grid
            2. Solar
            3. Generator
            4. Meter is not working

12. How would you describe your school setting?

    a. Urban
    b. Rural
    c. Tribal

13. What is the farthest that students travel to reach your school?

    a. 1 km
    b. 2–3 km
    c. 4–5 km
    d. More than 5 km
    e. Residential School

14. What type of headmaster does your school have?

    a. Headmaster
    b. In-charge headmaster
    c. School is not designated for headmaster/principal

School Support

15. Does your school receive regular support from resource persons from DIECPD?

    a. Yes
    b. No

16. What is the distance of your school from DIECPD/DIET?

17. How often does your school receive visits from DIECPD/SCERT staff?

    a. 1x/week
    b. At least 1x/month
    c. At least 1x/term
    d. Rarely
    e. None

18. How many times per year do teachers from your school receive professional development trainings?

    a. 0
    b. 1
    c. 2
    d. 3 or more

19. How would you rate your satisfaction with the support received from DIECPD/SCERT?

    a. Very satisfied
    b. Somewhat satisfied
    c. Somewhat dissatisfied
    d. Very dissatisfied

Digital Infrastructure

20. What kind of Internet facility is available in your school?
    a. Mobile network
    b. Wi-Fi
    c. Broadband
    d. Dongle
    e. No Internet

21. Which of the following Internet connectivity scenarios best describes your school's situation?
    a. Our school has a reliable Internet connectivity every day, and numerous devices can connect at once without a problem
    b. Our school has mostly reliable Internet connection. Only a couple or few devices can connect at a time
    c. Our school has an Internet connection, but there are regular outages, and/or only or two devices can connect at a time
    d. Our school does NOT have an Internet connection

22. How many of the below types of devices, in working condition, does your school have?
    a. Total number of computers _____
    b. Number of working computers _____
    c. Total number of laptop computers _____
    d. Number of working laptop computers _____
    e. Total number of tablets _____
    f. Number of working tablets _____
    g. Total number of projectors _____
    h. Number of working projectors _____
    i. Total number of TV/LED _____
    j. Number of working TV/LED _____
    k. Total number of Smart TV/Android TV _____
    l. Number of working Smart TV/Android TV _____

Teacher ICT Integration

23. Are there teachers in your school who use technology to prepare their lessons (i.e. research the topic online, finding resources to share in class, etc.)?
    a. Yes
        i. If so, how many? _____
        II. If so, how often? _____
            1. Every day or almost every day
            2. At least once per week

3. Less than once per week
4. Once per month or less

b. No

24. Are there teachers in your school who use technology to deliver their lessons (i.e. using a projector to present slides, showing a video, etc.)?

a. Yes

i. If so, how many? _____

ii. If so, how often? _____

1. Every day or almost every day
2. At least once per week
3. Less than once per week
4. Once per month or less

iii. Please give one example of how technology is used by teachers in your school.

b. No

25. Out of following digital technology, which is mostly used for teaching learning process?

a. Video
b. Audio
c. PPT
d. Word document
e. Skype
f. None of these
g. Other (please specify)

26. Out of the working digital equipment in school, which is the *easiest* to use?

a. Computer
b. Laptop
c. Smartphone
d. Tablet
e. LCD projector
f. Interactive whiteboard
g. TV/LED
h. Smart TV
i. TV with android stick
j. None of these
k. Other_____

27. Out of the working digital equipment in school, which is *most used*?

    a. Computer
    b. Laptop
    c. Smartphone
    d. Tablet
    e. LCD projector
    f. Interactive whiteboard
    g. TV/LED
    h. Smart TV
    i. TV with android stick
    j. None of these
    k. Other _____

28. How many tech-savvy teachers are in your school?

29. How many teach-savvy teacher trainings have been held for teachers in your school?

30. What was the focus of the training?

    a. Introduction of ICT
    b. Use of ICT in teaching learning process
    c. Use of ICT in evaluation
    d. Use of ICT in management
    e. Other _____

31. What teaching methods, in general (with or without ICT), are most commonly used in your school? Select the top 3 most used methods.

    a. Lecture method
    b. Discussion method
    c. Individual work
    d. Pair/group work
    e. Teacher demonstration method
    f. Student demonstration method
    g. Activity-based learning
    h. Constructivism
    i. Watch and Stop approach
    j. Other _____

Digital Content Availability

32. Check any of the below software/digital resources that your school uses on any of its devices. If you don't use digital content in your school, leave it blank.
    a. Kompkin
    b. GuruG
    c. BSNL
    d. Nalanda
    e. DIKSHA
    f. eBalBharati
    g. Khan Academy
    h. YouTube
    i. Microsoft teacher platform
    j. Self-made e-content
    k. DO NOT USE digital content
    l. Other _____
33. How satisfied are you with the availability of content for your subject?
    a. Very satisfied
    b. Somewhat satisfied
    c. Don't know/Not interested
    d. Somewhat dissatisfied
    e. Very dissatisfied
34. Do you have any expectations from e-content?
    a. Yes
        i. If yes, what are the expectations you have?
            1. E-content should be available as per grade/class
            2. E-content should be available as per Board
            3. E-content should be available in various options
            4. E-content should be available in mother tongue
            5. E-content should be available in English
            6. E-content should be available in the form of worksheets, practice question papers, etc
            7. Other _____
    b. No
35. What kind of additional content would be useful for your school (e.g. considering language, local relevance, etc.)? *(optional)*

Digital Community Engagement

36. How would you describe your school's web presence? Check all that apply.
    a. We have our own website
    b. We have our own YouTube channel
    c. At least one of our teachers has a content/YouTube channel
    d. We have social media pages (Facebook, Twitter, etc.)
    e. We access/use the default government-provided website
    f. Our school has its own blog
    g. At least one of our teachers has their own blog(s)
    h. We are not present online
    i. Other _____
37. How does your school engage with parents in the community? Please rank those that apply, starting with one for most commonly used method.
    a. In-person meetings in school _____
    b. Outreach to communities by school representatives _____
    c. Announcements/letters sent home _____
    d. Phone calls _____
    e. Short Message Services (SMS)
    f. WhatsApp messages/groups _____
    g. School Management Committees (SMC)
    h. Other _____
38. Which of the following digital equipment did your school receive from social contribution/CSR?
    a. Computer
    b. Laptop
    c. Smartphone
    d. Tablet
    e. LCD projector
    f. Interactive whiteboard
    g. TV/LED
    h. Smart TV
    i. TV with android stick
    j. None of these
    k. Other
39. Please upload a photo of your school's ICT facilities/equipment.