The Power of Data Science Ontogeny: Thick Data Studies on the Indian IT Skill Tutoring Microcosm

Nimmi Rangaswamy and Haripriya Narasimhan

INTRODUCTION

> Now you can pursue world class courses on Indian soil … we are grooming a new generation of global Indians. … Join now and be the best. (A 'computer institute' brochure in small town India)

India's large under-twenty-five adult population has stoked huge demand for technical, IT job-ready education. India is home to the largest under-twenty-five demographic profile in the world, 604,394,787 people and 49.91 per cent of the total population (Census, 2011), requiring a

N. Rangaswamy (✉)
Kohli Centre on Intelligent Systems, International Institute of Information Technology, IIIT, Hyderabad, India
e-mail: nimmir@iith.ac.in

H. Narasimhan
Department of Social Anthropology and Sociology, The International Institute of Technology, Hyderabad, India
e-mail: haripriya@iith.ac.in

widespread, skill-oriented educational model, equipping youth to thrive in highly dynamic job markets. Strewn across India are private skill tutoring training centres and this chapter draws from ethnographic research conducted in Ameerpet, arguably India's largest IT skilling hub, a suburb in the Hyderabad Metropolis in the state of Telangana, South India, and Kumbakonam, a mid-sized town in the state of Tamil Nadu, South India. We undertook this research to explore the notion of information technology's (IT's) pervasiveness existing in a physical tutoring model of classroom teaching. Students marginalised in the more formal and competitive education system flock to Ameerpet-like IT skill hubs in preparation for the cut-throat job market. Small towns like Kumbakonam lack quality educational institutions like the Indian Institutes of Technology (IITs) or state-run public educational institutes. The IT skill tutorial institutes function like undergraduate colleges imparting engineering education, some of them are even like 'finishing schools' claiming to teach 'spoken English' and soft skills like 'social interaction and presentation' accompanying 'world class' computing skills. In the course of time, "there is a mystique of 'excellence' with commercial computer-training centres peddling a rhapsodic invocation of excellence which expect it to perform miracles in the absence of basic systemic changes" (National Employability Report, 2016). Both Ameerpet and Kumbakonam are about the aspiring college-going student population engaged in transforming opportunities within their lifetime. Aspirations are no longer about employment alone; it is about getting a toehold in a technology-driven, globalising world. Kumbakonam and Hyderabad are local contexts transforming to embrace global aspirations through hyper-local ecosystems such as the IT tutorial hub, a stepping stone to IT employment.

Fifty years ago, a call for a reformation of academic statistics pointed to the existence of an as-yet unrecognised *science* that learnt from data (Davenport & Patil, 2012). The catchy name 'data science' urged academic statistics to expand beyond theoretical statistics and statistical modelling to data preparation and presentation and on prediction rather than inference. Data sciences is the generalisable extraction of knowledge from data and is also an information science focused on the collection, analysis, visualisation, and management of large amounts of data (ibid.). For young adults in India, the power of data science ontogeny influences the future of work and a career in a new digital age with all its accompanying challenges. The digital environment and future educational and industrial human resources need data science programs. In the past five years, the

data sciences evolved techniques for the (automated) analysis of data and expected data scientists to be high-ranking professionals "making discoveries while swimming in data", which implies implications for new business directions (ibid.). Data scientists are envisioned to work with technologies so as to put big data to use, sometimes in the service of new solutions, services, and applications.

Formal education in the data sciences, broad in scope and dynamic in content, remains a challenge to traditional educational departments. Data scientists, even today in India, acquire big data skills outside of the formal education system. Additionally, pedagogic concerns in the creation of knowledge from big data, evolving and expanding a formal curriculum to keep pace with cutting-edge data science technologies create further challenges. Around 1.5 million students in India graduate each year with an engineering undergraduate degree (Varshney, 2006). The lack of a job-ready education system and a burgeoning demand for IT skills have rendered the Indian youth ill-suited to gaining employment in technical professions. The need of the hour is a comprehensive, across the board, scalable, skill-oriented educational system equipping young people to survive and thrive in highly dynamic job markets (LaDousa, 2007). Gaps in skill education and suitability for the IT job market are currently being addressed for job-oriented skill tutoring. The advent of online education and blended learning in the Global North points to a possible solution for India too, but online learning for the Indian consumer has thus far consisted primarily of importing courses designed in and for the Global North posing many challenges in deriving value out of the online courses in their current form. Massive Open Online Courses (MOOCs) continue to remain contextual in nature lacking student retention from sign-up to course-end (LaDousa, 2005; Rosé et al., 2014). The geographical scale of the Indian sub-continent, variation in language and cultural contexts, and diversity in the levels of student capacities to learn and participate in the education system present additional challenges to scale quality educational systems (LaDousa, 2007).

A groundswell of the informal skilling industry in India has been actively responding to this skill gap since the 1980s—a response that the current education system is unable to deliver (Patibandla & Petersen, 2002). IT tutoring institutes dot the skyline of Indian metropolises, cities, and small towns imparting IT skills that cater directly to the job market. Students join these institutes in large numbers, attracted by the short-term time commitment and the clear match between their goal of attaining

work and what the institutes offer (Joshi et al., 2018). Over three decades of commercially driven IT, skill hubs have evolved into tutoring models that youth segments in India are not only flocking to but finding educational value in persisting with their training. This chapter probes the Indian commercial skill tutoring market that continues to proliferate as our research field. We investigate the research site to understand the social profiles of learners and the perceived efficacy of the Ameerpet-like ecosystem and small-town micro hubs such as Kumbakonam over the formal education system in India for IT industry-ready skills.

AN OVERVIEW OF TECHNICAL EDUCATION, HIGHER EDUCATION, AND UNEMPLOYABILITY IN INDIA

This section will elaborate on the context of higher education in India, addressing gaps in the education system, especially in the areas of employability and job readiness. India is home to the largest under-twenty-five demographic profile in the world—604,394,787 people (49.91 per cent of the total population) (Census, 2011; Statistics Times, 2016; Joshua, 2014). The combined forces of an ill-qualified education system and a burgeoning international IT job sector has stoked the youth in India to seek job-ready data science education for gainful employment. Around 1.5 million students graduate each year with an undergraduate engineering degree (NIC, 2017). The combined strengths of the Indian government and corporate bodies, well aware of the widespread demand for job-oriented data science education, are yet to successfully address the situation. In 2017, there were a total of 6447 approved technical institutes, which enrolled 2,871,007 students (All India Survey of Higher Education, 2012). Out of these institutions, the top government-backed institutions that are recognised in the Global North, such as the Indian Institute of Technology (IIT), make up only a small fraction of the total intake (the total number of seats offered in all Government Funded Technical Institutes [GFTIs] in 2017 was a mere 36,200) (Mohammad et al., 2014). There is no denying the acute shortage of technical schools in the country to cater for the 1.5 million young Indians leaving high school every year. More importantly, competition for admittance is extremely high. The acceptance rates at these institutions are the lowest in the world by a wide margin, with the IIT acceptance rate of 0.7 per cent in 2014 being eight times less than that of Ivy League institutions such as

Yale and Harvard (Quality Council of India, 2016; Toppr, 2015). Given the extraordinary level of competition in quality conscious, 'first tier' institutions, many industrious students turn to a variety of other lower-quality technical institutions. These 'second-tier' institutions vary widely in terms of regulation, the number of students, examination patterns, syllabus, the quality of their faculty, and fee structures. State universities are run by the governments of each of these states and territories and cater to anywhere between 67,000 and 120,000 undergraduate students, distributed among their affiliate colleges. The best teachers opt for top ranking colleges or private institutions (which can match corporate pay packages) leaving many other schools thirsty for quality teaching staff (Kapur, 2010). Most low-quality institutions are unable to address the diverse backgrounds of their student body in terms of linguistic variation, varying levels of pre-existing knowledge, and previous training. Students we spoke to in Ameerpet, all of whom were from 'second-tier' institutions, alluded to the lack of out-of-class tutoring, mentorship, or guidance at their institutes. The uneven quality of teaching, a limited focus on practical knowledge, and the lack of participative classroom culture create an exam-focused atmosphere, with students focusing on memorising material rather than developing practical knowledge of the subject. A technical report places 18.4 per cent of the total number of engineering graduates generally employable and only 3.2 per cent suitable for jobs in the IT industry (National Employability Report, 2016)—emphatic evidence of the huge skill gap arising out of the Indian science and technology education system.

Jiazhi and Steinmüller (2021) plot and analyse the rise and growth of leadership and business coaching tutorship in China as a response to a changing sociopolitical environment. The movement of people from rural areas into the urban labour markets striving for upward social mobility views education and self-improvement as the primary means of realising that desire. The leadership and business coaching programme, apart from offering skill sets and job aspirations, signals the hopes and anxieties of the rising Chinese middle class in a new political context of entrepreneurship and emerging capitalist business culture. Our fieldwork in Ameerpet and Kumbakonam, apart from resonating with the above study, speaks to the educational gaps in the teaching of science and engineering in the context of a rising Indian off-shoring job sector.

METHODOLOGY AND FIELD SITES

This chapter is informed by primary data collected through a variety of qualitative methods. Between June 2017 and March 2018, we conducted fieldwork in Ameerpet, a dense bustling commercial suburb of Hyderabad city and the largest IT skill tutoring hub in India, largely run by the private sector, offering a plethora of courses ranging from robotic process automation to manual testing courses. Our ethnographic methods afforded us a first-hand experience of Ameerpet's social geography and enrolling in a course for six weeks helped us engage in an immersive classroom experience to get a contextual feel for the quality of teaching, tutors, class infrastructure, and student interactions. Unstructured interviews with students, tutors, and managers of IT skill training institutes helped us gather first-person data about the hub. These face-to-face, in-depth interviews helped us understand the importance and value of the Ameerpet institutes for students, the quality of tutoring, and the relevance of the syllabi. We developed social profiles of students and tutors to comprehend the motivations to study or teach at Ameerpet. Our depth of immersion and our interactions with key stakeholders in the Ameerpet tutoring system offered points of view to evaluate the offerings and implications of its ecosystem. In Kumbakonam, interviews were conducted among students at an IT training institute and staff at two schools and a few other IT training institutes in the town. Visits to engineering colleges on the outskirts of town and focus group meetings with students yielded interesting observations. Importantly, we produced an index of the technology infrastructure, computers, software, and peripheral devices servicing the IT skill training in classrooms. All our interviews were recorded, transcribed, and coded manually to analyse our research questions. More importantly, handwritten notes from field and classroom observations in regard to tutoring and pedagogic styles, student response, and classroom participation contributed significantly to the coding and analysis of data. We employed the inductive approach, also known as inductive reasoning, beginning with observations and the development of arguments based on these observations. We observed recurring patterns, resemblances, and regularities in the data to arrive at conclusions. These recurring patterns were developed into themes and aided in the manual coding of transcripts from which we were able to draw insights.

A response to the demand for basic and advanced IT skills in India is not only opportunistic but also pedagogic and industry-ready. This

response has been realised in the form of skill tutoring classes, driven and managed by the private sector offering short, condensed material promising job readiness in less turnover time than allegedly provided for in the formal Indian education system. Classroom pedagogic tools cater to and are customised for the effective imparting of IT skills to compete in the job market. The Ameerpet and Kumbakonam marketing and the course structure of classes identify and target employability as the key goal of students enrolled in their classes, offering a clear link between the skills they learn and the job market they are preparing to enter (Joshi et al., 2018). Estimates vary about the number of students taking these courses in Ameerpet—anywhere between 60,000 and 100,000 students per month (The Economist, 2017). Each institute in the hub offers multiple courses ranging from introductions to MS Office to Robotic Process Automation, with a fee structure varying across institutes and courses, from INR 2000 to as much as INR 35,000 for a single course (i.e. US $30–$550). The fees charged depend on the reputation of the tutorial centre and the quality of teaching and the teachers they employ. The turnover time for these institutions is rapid—courses last from one to six months and multiple batches for the same course are held in quick succession. The managers of the Ameerpet institutes update courses to tally with skills in the job market, mining information from online job portals and their own industry contacts to keep track of the latest demand for jobs. Kumbakonam town makes an interesting contrast to the metropolis of Hyderabad to showcase the ubiquity of computers and the internet. A town located 300 kilometres away from the metropolitan city of Chennai in South India is trying to negotiate its image as a *mofussil*, an "inferior" space, as a place "marked by slowness, by absence of the new and recent" (Fox, 1969). Kumbakonam is actively resisting the above definition by bringing the 'computer' into its 'everyday'. A visitor to Kumbakonam will be struck by the presence of a large number of 'net cafes', or 'browsing centres. Ethnographic studies in Kumbakonam town were conducted in the summer of 2009 when India had consolidated the IT wave.[1] Kumbakonam is a 'temple town', literally, a pilgrim town full of temples, situated on the banks of the river Kaveri with good transport links to the nearby cities of Chennai and Trichy. The Mahamaham festival, held every twelve years, during the Tamil month of Maasi (February–March) brings

devotees to the town to take a 'holy' dip in the Kaveri waters. Kumbakonam is also known as a trading centre for textiles, brass utensils, and gold jewellery. It may be a dusty town, but certainly not a sleepy one. The streets are constantly full of people. Long-time residents of Kumbakonam recall the town as being one of the best in the state for its schools and colleges. There are three schools that are over a century old. The 'Silver tongued' singer Srinivasa Sastri, the mathematical genius Srinivasa Ramanujam, and the well-known agricultural scientist M.S. Swaminathan are just some of the famous 'sons of the soil'. It is also a town that has recently seen a spate of 'modernising' infrastructural development comprising apartment complexes, a new university, a three-star hotel, a 'cutting edge' hospital, and at least one television channel dedicated to 24-hour news about Kumbakonam. The past 20 years has infused the city with a new 'life blood' in the form of aspirational behaviours to acquire modern devices and to adapt to the computing age.

THE AMEERPET IT SKILL HUB: THERE IS A SKILL JUST AROUND THE CORNER

There are 66 types of SAP courses on offer in the hub.—Ameerpet Instructor

Ameerpet draws students from all corners of India, who move to Hyderabad city specifically to enrol in a variety of courses. Their primary motivation is securing a job or upgrading their IT skills to advance an existing job profile. The hub attracts learners from neighbouring districts in Telangana to nearby states such as Andhra Pradesh and Orissa to the far-flung northeast states such as Manipur. International students, particularly from the Middle East and South-East Asian countries, are present in small numbers. The students usually have graduate degrees in different streams, most without work experience; there is also a considerable section of employed learners who join courses to upgrade their IT skills. Despite varied educational backgrounds, none of these learners has studied in India's top-tier colleges—most have degrees from unranked private colleges and state universities located closer to their homes. They choose to come to Ameerpet to learn the same skills which are primarily oriented towards teaching a focused set of content, one that is relevant for a specific job profile (Joshi et al., 2018). The language of jobs and job titles captivate prospective students and help them seek out courses that might align

with a potentially active job profile. Students aim and aspire for specific job profiles and seek to enrol in courses offering specific skills related to those profiles. While students gain skills as they progress in a course and are aware of the need for multi-skilling, they prefer to take courses that are clearly tailored for a job profile instead of courses geared towards a generic skill set.

A prospective IT skill learner 'discovers' Ameerpet, seeks out specific institutions, and tutors with the help of a robust information network. Anthropological literature alerts us to the significance of informal networks in low-resource, developing economies. In these spaces, it becomes crucial to understand and tap into informal networks in order to disseminate information and pitch products (Espinoza, 1999). As Anant, 23, a student from the state of Orissa in Central-West India doing a Quality Testing course, told us, "I came here because my school mate who has now completed his engineering program and worked for a year told me about this place. I am in my final year and have dropped a semester to learn at Ameerpet. I am taking multiple courses on Java, Python and web design too." A good number of students we spoke to had similar stories to share about friends, colleagues, and family members (who have themselves taken courses in the hub and found work in the IT industry) directing them towards Ameerpet. Deepak, male, 21, another student in the same course from the relatively nearby city of Visakhapatnam, told us, "My elder brother got a job from here only. Everyone knows about this place; it is the best coaching centre." This reputation of Ameerpet being the 'best coaching centre' is fortified in the way information circulates through students who have benefitted and found jobs—many do not even attempt to probe alternative options such as exploring local institutes or online classes before settling for Ameerpet (Joshi et al., 2018). References from immediate social networks rely on existing trust in the social relations that recommend Ameerpet institutes. Further, social relations among students from similar socio-economic standing and with similar demands bolster faith in the selection criteria offered by these networks. Tutors at the Ameerpet institutes are ex-employees or moonlighting in the hub while holding down a day job in the IT industry, which assures students of the authenticity of their learning experience. Ameerpet success stories hover around institutions' placement records, as does anecdotal evidence from those who have found jobs after their time in Ameerpet.

Job attainment is a central goal among learners who enrol in Ameerpet and landing a job in the IT industry is their top priority when enrolling at

an Ameerpet institute. In a discussion amongst several students regarding placements and prospective salaries, Vishali, a young woman in her 20s, from the far away North-eastern state of Tripura, said, "What's the problem in starting from zero? We can start from the base, get experience then move ahead." In another discussion, Prakash, male, early 20s, a fresh graduate taking an SAP course, echoed this statement, "I want to get a job in the IT sector. … I don't care about the salary. Growth and money will come later, once the job is there." Students hear and believe that stable jobs in the IT industry, along with opportunities to go abroad, are definitional as career prospects (Joshi et al., 2018). Many were content with a non-technical work profile in the IT sector—a toehold in the IT industry promised a 'future of possibilities'. Tutoring institutions are aware of this demand and adopt several strategies to ensure course offerings align with the skills required for the IT market and constantly upgrade skill requirements. Managers of tutoring centres browse job portals and scour their networks in the IT industry to gather 'know how'. As, Sankar, a co-director at a fifteen-year-old institute, said, he spent several hours a week trying to figure out the current in-demand courses by looking at job portals. As Raman, a manager at a recently opened institute, explained to us, "If a student comes and says they have seen a course on a job website, and I don't have that course, then students will not come to me. Even if that course is not right for them and later I make them take another course, first I need to have the latest course on offer."

Instructors are a key industry link—a majority of them are employed IT professionals who moonlight as tutors in Ameerpet. They have insider knowledge of job profiles and what skills are in demand, the kind of skills and knowledge needed to learn tools, and modes of classroom delivery of course material so that students may fare well in job interviews. For instance, instructors stress the difference between 'course knowledge' and 'job interview proficiency'—tutors highlight sections of coursework that are important for interviews and train students to answer basic yet critical interview questions. Tutors decide course syllabi and could choose to not teach redundant software tools in favour of new industry standards. In the testing course undertaken by the first author, the instructor explained that he wouldn't be teaching a tool called QTP, QuickTest Professional, since it was no longer valuable in the job market (despite being listed in the syllabus), and would instead focus on 'Selenium', an open-source testing software platform, which was, in the instructor's words, "all the rage in learning testing tools".

The Ameerpet hub addresses job readiness and employability, key concerns for students looking for an employable job profile in India. Learners are alert to the alignment of a course towards a job profile for which they clearly see value in a job market. Institutions in Ameerpet manually scan job portals and use industry connections in order to identify the latest tools and IT industry trends. Online platforms can significantly refine this process with data mining tools to match what technical and soft skills recruiters are looking for at any given time and place. Project-oriented courses focus on teaching the entire skill set required for entry-level work in a particular job profile or stream. For example, the Testing Tools course in Ameerpet begins with an overview of software engineering and development; moves on to teaching Java programming skills that testers will require; students then move on to the use of various automation applications; and finally, students create and execute test cases as they would in a workplace. Similarly, an Android development course that lasts for two months begins with software installation, moves to coding in Java, and then to an overview of various APIs and their implementation for software applications. It is the packaging of an end-to-end learning and tutoring course structure that proves successful for the Ameerpet tutoring institute. The Ameerpet tutoring ecosystem, despite a narrow focus on the off-shored IT skill requirements, offered a spectrum of sometimes mind-boggling courses to meet the differentiated demands of a globalised IT job market.

The Coaching Micro Hubs of Kumbakonam

Now it's all 'e' … 'e-publishing', e-education, e-commerce….—Ramanan, Owner of a Computer Coaching Centre

A visitor to Kumbakonam will be struck by the presence of a large number of 'net cafes', or 'browsing centres'. It would appear that Kumbakonam is perennially online. One such 'cafe' is located in a non-descript building on a main road, right next to a stall making fried fast food. A very small room is divided into six cubicles on either side, each fitted with one computer, connected to the internet. All the government contract tenders are applied for online. High school exam results are published and train tickets are booked online. Even passport forms are now filled out online, as are applications for bank jobs. Most of the clients in internet cafes are, not surprisingly, college students who come to check their email, download

music, voice chat with friends and family, fill out application forms, and search for jobs. Naseer jokingly said that, in addition to name and address, one is now required to provide a mobile number and an email ID for most job and university applications; information technology is omnipresent in this *mofussil* town. The effect of IT, in the form of the mushrooming of tutoring centres designed exclusively for imparting skills and training in computer applications, is referred to as 'computer coaching centres', 'computer class', or 'computer institute'. Students in small towns like Kumbakonam feel marginalised, because of the lack of a global/cosmopolitan 'atmosphere'. They wish to participate in the growth they see in cities like Chennai and consequently abandon any interest in traditional occupations (Gupta, 2005). This lack of 'atmosphere' in the town works as a strong impediment to their perceived ability of achieving this goal. This results in a state of "educated unemployment" as more of a reality than the dream of participating in the so-called IT boom.

Being literate has increasingly come to mean being 'computer literate'. The perception is that "India has changed, the state of Tamilnadu has changed and, Kumbakonam town has changed as well". "Now it's all 'e' … 'e-publishing', e-education, e-commerce", says Ramanan, the owner of a 'computer coaching' centre. Anandi, an eighteen-year-old girl, studying at an arts college outside the town, and a student at Ramanan's institute, said that computers are omnipresent (*engum* computer) and "computers are everywhere and in everything", because "from small things to satellite launches everything is done through computers". Another student, Venkat, thought that he "didn't know anything" before he joined Ramanan's class because he did not know how to use a computer. Without a degree of computer literacy, any other kind of knowledge is considered irrelevant. During our informal interactions with high school students, at the cusp of choosing an undergraduate education, it became apparent that engineering was the subject of choice and Infosys, one of the first home-grown IT giants in India, was considered as one of the most desirable companies to work for. Computers are seen as a gateway to the outside world. Not one participant expressed a desire to study medicine or law.

Schools in Kumbakonam hold hopes that in ten years' time, "there will be a computer in each classroom". Coming from the principal of a school where blackboards on wooden stands separate one classroom from another, this statement might seem premature and overly optimistic. But the fact that all government administrative work is now computer-based

has allowed for a discourse on "the omnipresence" of computers in everyday life. The principal acknowledged that they hoped to create only "awareness" and not necessarily equip students with the required knowledge on how to use computers. Educational institutions in small towns are engaged in attempts to change their image as one of lacking resources and infrastructure facilities by investing in IT in a bid to regain a certain status and operationalise 'modern' education content (Kumar, 2006). At the undergraduate level, the resource and infrastructural gap between private and state-funded institutions is glaringly apparent, as are the gaps between students coming from Tamil and English language schools.

Private colleges have, to some degree, exploded in Kumbakonam over the last ten years including two engineering schools. The engineering courses' curricula are relatively demanding. Students write eleven papers per semester and twenty-two papers per year. In four years of study, they write eighty-eight papers in total. Students taking computer science as one of the four subjects in high school learn C and C++ in school but because they are not taught particularly well, they do not possess a full understanding of these languages. For those students who are first-generation college-goers, or who studied in a school where Tamil was the medium of instruction, an engineering education is full of obstacles that must be overcome, the least of which is the college's location (Fuller & Narasimhan, 2006). We argue that, yet again, the challenges of the low-quality formal education system are mitigated by the rise and evolution of commercial IT skill tutoring centres that bridge education and job readiness.

Computer Coaching Centres

Computer is like Laadam (rein) for a horse ... everything is held by computers.—
Saravanan, E-Cube coaching centre

One can see fluorescent pink and green wall posters across Kumbakonam announcing classes specifically set up to teach specific computer applications in anything from ten days to six months. It is striking to see that the IT industry is seen as the only field where progress can be achieved. As Ramanan said, "Students don't know the famous manufacturing firm Simpsons, but they all know about Wipro and Infosys". It is companies like these that students would prefer to join after their training, to partake, in some sense, in the globalisation experience. Computer coaching arrived in Kumbakonam in the early 2000s. Ramanan's 'Srinivasan computers' is

one such 'coaching centre', functioning out of the living room of an ancestral house in Kumbakonam. Ramanan is an unmarried, forty-year-old native of a smaller town nearby who had worked in Chennai teaching computing at a local institute. He decided to settle down in Kumbakonam and works in a local school during the day as manager of their computer lab. Ramanan's institute started in 1998 with one computer. Now he has ten to twelve "systems" and fifty batches of ten to twelve students per batch, each lasting for six months. A mix of both engineering and non-engineering, students, male and female, living in Kumbakonam or small towns nearby attend these classes. Students felt that their teachers in college were unable to teach them the skills they required to find work. For instance, in regard to C++, only fifteen software applications are taught on the college syllabus. They feel compelled to come to institutes (like Ramanan's) in order to learn the whole gamut of applications related to C++. Even if the current engineering syllabus at mainstream colleges is considered 'good', students are quick to criticise the staff for their inability to teach complicated languages and programs and their inability to speak English fluently (the running joke among students is that those who fail to get jobs become faculty in engineering colleges).

Branches of popular institutes (such as NIIT and Aptech that have a national presence) apparently had to close down branches in Kumbakonam due to a lack of trained faculty. The fee structure varies from one institute to another. Ramanan's institute proudly claims that "no course will cost more than INR 1500 or 25 $US". Computer Sciences Corporation (CSC) is a tutoring franchise and opened a branch in the late 1990s. The owner is a well-off farmer's son and has registered his disdain for agricultural occupations by founding CSC. CSC remains open from 7 a.m. to 9 p.m. Students receive about an hour's tuition per day. With 16 staff members and 330 students, CSC doubles its student attendance in the summer months. CSC teaches 'fundamentals', a word commonly used to denote a package of basic computer applications such as MS Word, Excel, PowerPoint, and Access, charging INR 2000 or US $70 for a two-month course. Most of the teaching is done in Tamil since many CSC learners are from rural areas. Much like the tutorial hubs of Hyderabad, students from out of town live in hostels or rent apartments in Kumbakonam and attend evening classes such as those run by Ramanan. Those from surrounding villages leave their homes at 6 a.m. to commute to class. The Professor said, "[W]e don't push them hard … we let them learn at their pace. … Students in Chennai are assumed to be able to 'tackle' the outside world,

while students from *mofussils* lag behind. In Chennai, students 'know the atmosphere', and know how to find work. Students in Kumbakonam, on the other hand, lack communication skills, motivation and understanding. Tests are, therefore, a struggle."

E-Cube, another computer coaching institute, presented itself very attractively, located in a fluorescent green building on the first floor above a tea kiosk selling local beverages. E-Cube has a small veranda at the front of the building leading to a large hall in which several plastic curtains separate 'class' sections. One end of the wall is lined with computers, again covered by curtains. The person running this institute, Saravanan, who works as faculty in the computer science department of a local college, said, "[C]omputers are like *laadam* (rein) for a horse … everything is held together by computers".

The institute is also involved in 'body shopping', web design, and various consultancy projects. Sujatha, the receptionist, has a master's in IT at the college where Saravanan was her teacher and commutes from a village about ten miles from Kumbakonam. Discussing the problems students face when studying programming languages, she said, "[M]oney problem [affordability], language problem [inability to understand English] … problems are obvious and we try to bring solutions". The commonly seen 'flexi boards' in Tamil Nadu require a fair degree of computer work. According to E-Cube's owners, most parents assume that their children can survive just by making flexi boards, and prefer that they study 'computers' instead of more traditional occupations. Institutes like E-Cube 'take students through the "first step" of gaining some knowledge in computers', offering a 'stepping stone' towards advancement and opportunities to 'study further' in Chennai. Tutors like Saravanan begin by making students "learn how to switch on a computer and familiarise themselves with its functions". Institutes set up in the hope that the density of Kumbakonam and the nearby areas would attract large numbers of young adult learners. Posters on the walls at this institute announce to visitors, "Now you are in the world of success". The front office is supposedly 'posh', with nice sofas and well-dressed female staff on the front desk. Glass doors lead to classrooms labelled 'computer lab', which look very sophisticated in the context of a small town. The idea is to provide students with a visual imagery of a modern setting which they may not have access to, even in the colleges they go to for their main studies.

Another critical requirement for towns like Kumbakonam is the prospect of a job, preferably in the IT industry. Learners felt the acute lack of

privileges that cities and metropolises in India afford; the possibility of employment that begins with the 'campus interview' or the opportunity a good quality formal educational institution can offer to attract IT companies to recruit their graduates. A college gains its reputation partly through the firms that recruit from each cohort, which in turn depends on the reputation the college already enjoys as a consequence of students achieving high grades. Not many industries visit Kumbakonam colleges for interviews but that has not constrained the young who hope and aspire to land an IT job in the cities of Tamil Nadu.

BEYOND DEVELOPING IT SKILLS TO EMPLOYMENT

Ravi comes from the Thevar community, traditionally a small agricultural community in Kumbakonam. His father is a farmer, but more importantly, he is also a traditional village chief (naataamai). But Ravi is not interested in agriculture or getting involved in the numerous conflicts that take place both within and between villages. Like most young adults and students in the town, he is the first member of his family to go to college. As his parents and his extended kin group do not speak English, Ravi is really "frustrated, finding it difficult to practice speaking the English language at home". In the company of friends and college mates, Ravi is further handicapped by another problem because, he said, "if a person wishes to speak too often in English that person is teased, ridiculed, mocked, and almost ostracised. Such social control acts as a barrier to my desires to 'develop' (munnetram)." Ravi feels he will have to leave Kumbakonam and go to Chennai in order to develop his English language skills.

The tutoring hub's learning model develops a robust understanding of the cultural and contextual aspects that may affect an individual student's education; the why and what of students flocking to the hub; the professional goal of these learners in seeking courses offered by the tutoring hub. In tweaking course content and pedagogic style to match student learning capacities and in revising the syllabus to reflect the current market and job readiness, the hubs cater for a wide range of students coming from diverse socio-economic backgrounds. The tutoring hub in Hyderabad and the coaching centres in Kumbakonam not only teach IT skills but also offer additional services to guide students in the enhancement of their job prospects. Students are able to download and fill sample résumé templates; staff share links and forward job announcements by email; certificates are provided upon the completion of coursework; and work experience is provided off-site where the opportunity arises when a member of staff also

work in the wider IT sector. A range of soft skills are imparted in the course of software training. Part of developing a 'personality' suited for a global India is in the attainment of fluent English skills and most 'personality development' classes include 'spoken English' classes. In Kumbakonam, the most popular has been operational for almost thirty years. It is run by a retired English professor and his wife. The course runs from April to June, during summer vacations, and costs an individual learner INR 1800 or US \$25. The class recruits several hundred students each year. Workbooks and files given to students are mostly the type of English grammar found in high school textbooks. The manager of the institute stated that students are taught to write grammatically correct English and then to speak in English. The standard of English among the learners was so poor that "they needed to learn to write properly before they spoke properly". Courses that go beyond IT skill building offer learners the opportunity to develop their 'creative writing', as well as their 'public speaking' skills and conduct mock interviews and group discussions. As one student explained, "we are taught how to get on to the stage and [these institutions] are similar to finishing schools … the idea to develop soft skills required by industry".

Job attainment is a central goal among students who enrol at tutorial hubs. Many of them were not concerned with their future job profile, or salary even, as Prakash, male, early 20s, a fresh graduate taking an SAP course, said, "I want to get a job in the IT sector. … I don't even mind if I end up with a non-technical work profile. Growth and money will come later, once the job is there" (Joshi et al., 2018). Tutoring centres adopt strategies to ensure course offerings align with the skills required. For example, a quality testing tool called QTP, no longer valuable in the job market, was replaced by 'Selenium', an open-source testing software platform. Tutoring centres offered job-enhancing services, such as résumé/CV templates, links to job portals and email forwards of possible opportunities and, more perhaps of more value, lab environments complete with desktops, employee ID cards, and biometric entry systems, where students learn the ropes of in simulated offshore workplaces. Some of the 'live labs' in the Ameerpet hub provide hands-on training in IT projects and offshore assignments "to reduce the gestation period" of a future employee in the IT industry. Employment and employability are not only student-recruiting mantras for hubs in Ameerpet and Kumbakonam, they function as gateways to IT-enabled employment for a sizable section of young

Indians while addressing the severe crunch in resources and manpower arising from the established Indian institutional educational sector.

The vignettes we offer in this chapter make a case for looking at 'data studies' from an ethnographic perspective. Our research uncovers a 'program' of upward mobility that has been scarcely investigated in India, though myriad studies exist on the desire for English language education (see LaDousa, 2005). Extensive studies of the IT industry's growth in India tend not to tap into the large, informal, and semi-formal training infrastructure which is key to the industry's 'success' (e.g., see Patibandla & Petersen, 2002). Computers have captured the imagination of the upwardly mobile middle classes since the 1990s but had largely escaped critical examination (as Krishna Kumar points out in LaDousa (2007)). Our aim here is to not just 'fill this gap' in literature but push forward a theoretical perspective on data from an ethnographic lens. What directions might a perusal of 'data' in the Indian context look like? The excerpts presented here articulate the varied expectations of those undergoing training in these institutes. It is largely about livelihood and yet it is also about aspirations towards a different way of life. Students at these institutes keep themselves abreast of the latest developments in the field. The objective is not merely to get a job, but to be in a position to use one's training as a vantage point from which to achieve upward mobility. In Kumbakonam, that meant moving to Chennai for jobs. In Chennai, it meant taking up an on-site project in the USA. But the aim is always beyond the immediate city, town, or one's home town.

Conclusion

Indian higher education seems like an enigma wrapped in a contradiction. Pockets of excellent teaching and research are surrounded by a sea of substandard colleges. The best graduates compete successfully in the world job market, but unemployment at home is the reality for many. Scholarship is often superseded by politics and, in many institutions, crisis is the norm. A system which was at one time highly selective has opened its doors to large numbers, yet at the same time there is conflict and sometimes violence over what remains a scarce commodity. (Altbach, 1993, p. 4)

IT tutoring curricula operates and is built with the express purpose of providing youth with skills that eventually lead to gainful employment. Globally, people are reskilling and upskilling themselves in the hopes of

becoming more competitive in the labour market, but how will these skills translate into employment opportunities? What are the most effective ways for people to learn and apply ICT skills across diverse population types and socio-economic contexts (Garrido et al., 2009)? Employability encompasses a combination of factors that demand an exploration of the role IT skills and skilling play in educational contexts and their relevance for IT-enabled employment in particular. The challenge for researchers is to speak of employability, drawing on specific educational ecosystems and their evolution against the broader context of globalisation and the intense competition for knowledge labour. Private, market-driven IT tutoring non-governmental organisations training young Indians to improve employment opportunities act as *liaisons* between the desirous IT sector and the means to acquire capabilities to get a toehold on the ladder of skill upgradation.

Globalising countries like India are transforming into information technology service hubs but are paying scant attention to the creation of new education models to suit employment in the IT industries. Government expenditure on education in India is only 3.8 per cent of GDP, compared to the world average of 4.8 per cent (All India Survey of Higher Education Report, 2012). Despite the large numbers of engineering graduates (Mahajan, 2014), only 18 per cent of graduating engineers in India were employable in roles for the ICT industry. The poor quality of privately provided engineering education in India is attributed to the high levels of competition of getting a place in one of a small pool of quality institutes, poor government investment in technical education, and what Akerlof (1970) calls "informational asymmetry" between institutions and students. The latter has pushed quality engineering education out of the market to allow "lemons" (or low-quality education) to dominate the field.

IT skills and coaching hubs in Ameerpet and Kumbakonam have functioned to fill gaps in job readiness and employability, which are key concerns for students. In places like Kumbakonam, the 'pain' of living and being educated in the 'provinces' point to the Indian state's inability to deliver "progressive, successful" educational paths for its young population (Kambhampati, 2002). In spite of an ineffectual education system, the young learners in Ameerpet and Kumbakonam remained extremely optimistic about their place in a global India. They do not subscribe to Gohain's view of "drugged incuriosity and intellectual paralysis" characteristic of many marginalised spaces and their peoples (Gohain, 1997). The hubs do not offer Ivy League education, nor are they necessarily

institutes of excellence. However, what they do well through a widespread, scalable, skill-oriented educational system is to channel the young population in India through routes where they might find ways to survive and thrive in highly dynamic job markets. As global IT sectors become knowledge-centric, the skills related to information-intensive employability make visible the growing gap in the ability of existing educational systems and IT job readiness. This chapter has sought to offer a specific response to bridge gaps in data science education and skill development, thereby addressing a key condition for narrowing the employment and skill gap, one negative symptom of a burgeoning IT sector.

REFERENCES

Akerlof, G. A. (1970). The market for lemons: Quality uncertainty and the market mechanism. *Quarterly Journal of Economics, 84*(3), 488–500.

All India Survey of Higher Education Report. (2012). https://dhte.py.gov.in/sites/default/files/aishe-final-report-2011-12.pdf

Altbach, P. G. (1993). The dilemma of change in Indian higher education. *Higher Education, 26*(1), 3–20.

Ameerpet. (2017). India's unofficial IT training hub. *The Economist*, March 30, 2017. https://www.economist.com/business/2017/03/30/ameerpet-indias-unofficial-it-training-hub

Census of India. (2011). https://censusindia.gov.in/2011-common/census-data2011.html

Davenport, T. H., & Patil, D. J. (2012). Data scientist: The sexiest job of the 21st century. *Harvard Business Review, 90*(10), 70–76.

Espinoza, V. (1999). Social networks among the urban poor: Inequality and integration in a Latin American city. In B. Wellman (Ed.), *Networks in the global village* (pp. 147–184). Westview Press.

Fox, R. (1969). *From zamindar to ballot box: Community change in a north Indian market town*. Cornell University Press.

Fuller, C. J., & Narasimhan, H. (2006). Engineering colleges, 'exposure' and information technology professionals in Tamilnadu. *Economic and Political Weekly, 41*(3), 258–262.

Garrido, M., Badshah, A., & Coward, C. (2009). *Deconstructing ICT skills and employability*, Vol 5, Issue 2 | Summer 2009 (Special Issue: ICT Skills & Employability), Information Technologies and International Development.

Gohain, H. (1997). In search of scholarship. *Economic and Political Weekly, 32*(1–2), 26–27.

Gupta, D. (2005). Whither the Indian village: culture and agriculture in 'rural' India. *Economic and Political Weekly, 40*(8), 751–758.

Jiazhi, F., & Steinmüller, H. (2021). Leadership programmes: Success, self-improvement, and relationship management among new middle-class Chinese. *Ethnos.* https://doi.org/10.1080/00141844.2020.1867605

Joshi, M., Joshi, T., & Rangaswamy, N. (2018). Scaling classroom IT skill tutoring: A case study from India. *Proceedings of the 2018 ACM Conference on Human Factors in Computing Systems* Paper No.: 630. 1–12.

Joshua, A. (2014). Over a quarter of enrolments in rural India are in private schools. *The Hindu*, January 16, 2014. http://www.thehindu.com/features/education/school/over-a-quarter-of-enrolments-in-rural-india-are-in-privateschools/article5580441

Kambhampati, U. S. (2002). The software industry and development: The case of India. *Progress in Development Studies, 2*(1), 23–45.

Kapur, D. (2010). Indian higher education. In C. Clotfelter (Ed.), *American universities in a global market.* University of Chicago Press.

Kumar, N. (2006). Provincialism in modern India: The multiple narratives of education and their pain. *Modern Asian Studies, 40*(2), 397–423.

LaDousa, C. (2005). Disparate markets: Language, nation, and education in north India. *American Ethnologist, 32*(3), 460–478.

LaDousa, C. (2007). Liberalisation, privatisation, modernisation, and schooling in India: An interview with Krishna Kumar. *Globalisation, Societies and Education, 5*(2), 137–152.

Mahajan, A. (2014). 1.5 million engineering pass outs in India every year, fewer getting hired. *Dazeinfo*, October 28, 2014. https://dazeinfo.com/2014/10/28/1-5-million-engineering-pass-outs-india-every-year-fewer-getting-hired-trends/

Mohammad, M., Alsaig, A., & Alsaig, A. (2014). Introducing context-awareness to MOOC systems. *Proceedings of the 3rd International Conference on Context-Aware Systems and Applications.* ICST, Brussels, Belgium. 48–56.

National employability report: Engineers. (2016). *Annual report 2016.* Aspiring Mind. https://www.scribd.com/document/350743380/National-Employability-Report-Engineers-Annual-Report-2016

NIC. (2017). JOSSA seat information. http://josaa.nic.in/SeatInfo/root/SeatMatrix.aspx

Patibandla, M., & Petersen, B. (2002). Role of transnational corporations in the evolution of a high-tech industry: The case of India's software industry. *World Development, 30*(9), 1561–1577.

Population of India. (2016). Statistics Times. http://mospi.nic.in/statistical-year-book-india/2016/171

Quality in School Education Report. Quality Council of India, New Delhi. (2016). https://pdf4pro.com/view/quality-in-school-education-quality-council-of-india-4b246a.html

Rosé, C. P., Carlson, R., Yang, D., Wen, M., Resnick, L., Goldman, P., & Sherer, J. (2014). Social factors that contribute to attrition in MOOCs. *Proceedings of the first ACM conference on Learning @ scale conference (L@S '14)* ACM, New York, NY, USA, 197–198.

Toppr. (2015). Why IIT JEE is the toughest exam in the world? https://www.toppr.com/bytes/iit-jee-toughest-exam/

Varshney, L. R. (2006). *Private engineering education in India: Market failures and regulatory solutions.* Unpublished manuscript, Department of Science, Technology, and Public Policy, Massachusetts Institute of Technology, Cambridge, MA.