FOSS in Education: IT@School Project, Kerala, India

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Abstract—IT@School Project is termed the single largest simultaneous deployment of Free and Open Source Software (FOSS) based Information and Communication Technology (ICT) education in the world. It was setup in 2001 as a project of Department of General Education, Government of Kerala to foster Information Technology (IT) education in schools. Capacity Building in ICT is one of the prime objectives of IT@School Project; it also integrates diverse activities such as content development, infrastructure deployment, satellite based education and e-Governance initiatives in a holistic manner. We believe that the innovative experiment happening in Kerala has important lessons for both the developing and the developed regions. Concerns centre on the sustainability of the FOSS-based Kerala model and whether the FOSS advocates and activists are able to extract from governments a commitment to policy continuance.

I. INTRODUCTION

Capacity building in Information and Communication Technologies (ICTs) in Kerala, region of India has not received the academic attention it duly deserves. ICT training in Kerala has been taking place through two major initiatives. Akshaya centres, following a Public-Private Partnership (PPP) model provide ICT training and access to computers to the people of Kerala. IT@School Project ensures that school children are imparted with computing skills to empower them to participate better in the constantly changing networked world and in the evolving national and regional e-Governance. With these two initiatives, the government hopes to address the issue of digital divide in a holistic manner. In this exploratory paper we are discussing adoption of Free and Open Source Software (FOSS) in schools in Kerala as an integral part of IT@School Project.

The south Indian State of Kerala has more often than not, been hailed as a 'Model of Development' for its high human development scores comparable with that of many advanced countries, attained and being sustained with a much lower per capita income [8], [3]. Model or not, evidence of Kerala's development experience, as reflected in objective indicators like Human Development Index (HDI), Physical Qualities of Life Index (PQLI), Education Development Index (EDI) and Gender Equality Index (GEI) is highly remarkable. Achievements in universal literacy, universal health care, low mortality rates, high life expectancy, sex ratio favouring women, relatively better gender equity, tumbling fertility

rates, presence of smaller family units are some of the positive outcomes of Kerala development experience, prompting one to observe that the rest of India and developing countries have much to learn from it [9].

This small State with very high density of population (859 per sq.km as per 2011 provisional census), covering just about 1.2% of the area of the country, is home to 2.76 percent of the total population of India, and has had a history that is very different from the rest of the country. In 1957, Kerala became the first major province anywhere in the world to democratically elect a Communist government, instrumental in introducing land and educational reforms - two important milestones in the history of the State. Kerala has been the venue for several social reform and political movements including Sree Narayana Movement (from 1800s), left political movement (from 1930s), library movement (from 1940s), Science and Literary movement (since 1960s), Total Literacy Campaign (1989-91), localized people's environmental movement, for e.g., Silent Valley (1976) and movement against exploitation of water, pesticides (since 2000s).

Free Software Movement (since 1990s) is the only movement in Kerala, advocating the adoption and utilization of a specific technology. Like other social movements in Kerala, this 'freedom movement' is essentially radical in nature. FOSS advocacy, a digital rights and social justice movement has expanded beyond the terrain of software developers [18]. This mode of public action in the broad sense of 'using social means to prevent deprivation and vulnerability' has been hailed by scholars like Drez and Sen (Drez and Sen, 2002). From the Kerala experience, they conclude that great social security can be achieved 'if public action is aimed at promoting people's basic entitlements and capabilities' [2], cited in [13]. While State action is important, what the public does for itself, including the contributions of social institutions and the efforts of Non-Governmental Organisations (NGOs), pressure groups, activists etc. has contributed to human development in Kerala [13]. Free and Open Source Software integrates social movement (signified by Free as in Freedom) and software development methodology (Open Source, denoting collaborative design) [24], both compatible with the ethos of Kerala. The effective freedoms of the user to run the programme for any purpose, study and change, redistribute copies and distribute copies of modified versions

embedded in Free Software [5] expands the scope of basic entitlements and capabilities. In this paper we argue that it is the combination of public action by a group of technologically independent Keralites, and a progressive government that has resulted in the adoption and diffusion of FOSS in the school education system of Kerala.

Historically, perhaps the single most critical factor in Kerala's development scenario is its consistent track record in education. As early as in 1817, the young woman ruler Rani Gouri Parvathi Bai of the then princely State of Travancore (one of the three provinces to form the State of Kerala; others being Kochi and Malabar) issued a royal proclamation that 'the State should defray the entire cost of the education of its people in order that there might be no backwardness in the spread of enlightenment among them, that by diffusion of education they might become better subjects and public servants...'. Sen perceives this as a benchmark [20]. The concept of capacity building for participation and administration in a civil society was embedded in this proclamation, long before these concepts were introduced into the collective discourse.

The school education sector has State owned schools, along with State aided and unaided schools run by religious, communal and commercial organizations, with a centralized syllabus. At present, there are 12,479 Schools consisting of 6,774 Lower Primary (LP) Schools, 2,986 Upper Primary (UP) Schools, 2,874 High Schools (HS) and 1,845 Higher Secondary Schools (HHS) in the State. Of these, 5,250 are Government Schools (2,528 LP, 899 UP, 1,066 HS and 757 HSS), 7,947 are Private aided Schools (3,979 LP, 1,870 UP and 1,429 HS and 669 HHS) and 1,282 are Unaided Schools (267 LP, 217 UP and 379 HS and 419 HSS). In addition to these, there are 102 Teachers Training Institutes, 43 Special Schools for the handicapped children and 8 Anglo Indian High Schools (Government of Kerala, Department of General Education, 2011). Kerala has the highest literacy among all the States in India and tops the composite Education Development Index (EDI) on elementary education among 21 major States in India since its introduction in 2006-2007 (Times of India, The Statesman, 2011).

II. IT@SCHOOL PROJECT, KERALA

In the transition from industrial age to knowledge age, all forms of societal institutions are undergoing rapid change, facilitated by, and in response to the dramatic developments in ICTs. Preparing students for work and citizenship being one of the goals of education , schools are attempting to change their policies, practices and curriculum to meet the challenge of making pupils ready for a future quite different than the immediate past [27]. IT@School Project is an attempt in this direction. In this section we trace the origin and evolution of the world's largest simultaneous deployment of FOSS based ICT education [17].

Dr. V. Sasi Kumar, a FOSS activist, describing the evolution of IT@School Project and its later adoption of Free Software sees it as a result of several serendipities involving quite a number of individuals and organizations. He attributes the origin of IT@School Project to a suggestion by Dr. Roschen

Sasikumar, a scientist working at the National Institute of Interdisciplinary Science and Technology, Thiruvananthapuram, to introduce IT in school education. The suggestion was made to K. Jayakumar IAS, a senior bureaucrat at the Education Department of Government of Kerala (GOK). It was in response to this suggestion that GOK appointed a Task Force in 2000 under the leadership of Dr. U.R. Rao, former Chairman, Indian Space Research Organization (ISRO). The vision document brought out by the Task Force envisaged ICT enabled education in Kerala schools by 2010. The Committee recommended that the teaching faculty in schools be empowered to use technology for enhancing the quality of curriculum delivery in the classrooms.

Information Technology (IT) adoption was at its early phases in Kerala during 2000, and consequently, most of the teaching community had very little IT skills. Hence the recommendation of the Committee was to introduce IT into Kerala school education initially at the High School level (Standards VIII to X). In November 2000, the Minister for Education, GOK, accepting the report 'IT in Education, Vision 2010' announced that the project would be implemented in phases, and in the first phase, about 100,000 teachers would be made computer literate. The next phase was to introduce IT in the school curriculum by 2002. The full integration of IT for teaching and learning was planned for 2010 and it was hoped that the school going children at all levels would have access to computers and Internet connection by then (Indian Express, 2000).

A 'Society for Promotion of Alternative Computing and Employment' (SPACE) document tracing the origin and history of IT@School Project and its migration to FOSS notes that GOK in the beginning did not have a technology policy nor any guidelines for use of software. However, in the beginning, the State Council of Education and Training (SCERT) had planned the school syllabus necessitating the use of a proprietary operating system and software. The activists of Free Software Foundation of India (FSF India) found this unacceptable.

By the year 2000, Intel Asia Electronics had initiated a training programme 'Intel Teach to Future', for teachers all over India. Their syllabus was based on Microsoft technologies. By 2002, 300 teachers of Kerala were trained in proprietary software with the professional support of Intel Asia Electronics. By then the first IT textbook for Standard VIII based on proprietary software was issued and 18,000 teachers were trained in Windows and MS office course curriculum [16].

The schools in Kerala were expected to develop the required infrastructure with the support of local self-government and neighbouring communities. The majority of schools in Kerala had inadvertently started using illegal versions of proprietary software, without realizing the legal and moral implications. Microsoft Corporation, with the help of police, raided schools for pirated versions of their software. The free software community under the leadership of FSF India started campaigning against the use of

proprietary software in education. Their campaign in 2002 was based mostly on ideological constructs and to an extent, pragmatic considerations. The free software activists argued that promoting vendor-specific software was unethical, would lead to monopoly, create dependency and would also lead to significant cost by way of licence fees. The fines for using unlicensed software would be huge, and entering into licensing agreement would invariably result in 'vendor lock-ins'. Driven by the ideology of Free Software, they were critical of the non-disclosure/secrecy of codes used in the proprietary software, and warned that adoption of proprietary software would stifle creation of software development skills.

The Kerala State Teachers Association (KSTA), a trade union of teachers, joined hands with the Free Software Movement activists against using proprietary software in the public education system. The public action of campaigns and sensitization forced GOK to include Linux and Open Office as optional subjects in the curriculum for 2003, thus assuming a technology neutral policy. This could be termed the first turning point in the adoption of FOSS in Kerala's education system. Some teachers in the State run schools, especially in northern Kerala had installed GNU/Linux and started teaching IT using FOSS. However, the IT@School Project continued imparting proprietary software based training, ignoring the need for training teachers in Free Software applications. KSTA conducted a survey on IT@School Project among the teachers and other stakeholders, and the findings revealed that around 60 per cent of the schools used unlicensed software, and 43 per cent of the Head Masters (Heads of Schools) were unaware of the piracy aspects. In the absence of mechanisms to monitor illegal use of proprietary software, the IT@School Project officials admitted that the training centres also used unlicensed versions of software for training.

In the academic year 2003-04, the education department using a software application called Softexam, designed exclusively for MS Windows platform, introduced an online IT examination for Standard IX students. Those schools using GNU/Linux had to install MS Windows to enable the software. KSTA organized protests demanding installation of FOSS in all schools (Down To Earth, 2008). The government officially agreed to include Free Software in future, and thus started the migration of IT@School Project to GNU/Linux platform. In 2004, the project, with the support of FSF India and Kerala IT Mission, developed a customized GNU/Linux version, naming it IT@School GNU/Linux. In 2005 the GOK declared that the project would complete its migration to Free Software in phases. During the same year, the IT@School Project, with the support of Model Engineering College, Ernakulam, completed the first phase of teachers' training in Free Software, and in 2006, a revised version of IT@School 'GNU/Linux Light' suitable for computers with low memory was introduced. From 2005-06 academic year, IT syllabus gradually changed exclusively to Free Software, and IT examinations were conducted using Softexam on Free Software platform since March 2006. Kerala became the first

Indian State to fully adopt FOSS in school education.

Several e-Governance initiatives for the General Education Department of GOK have been initiated as part of the IT@School Project. These include Single Window admission system for Plus One admissions, Noon meal distribution computerization, part of the State level Secondary School Leaving Certificate (SSLC) examination work, Total Physical Fitness Programme software etc. Even after the successful migration to FOSS, there seemed to be some 'aberrations to the government policy'. FSF India, in their letter to the Education Minister on 26th June 2008 complained that proprietary software is being used in some e-governance projects like Higher Secondary Single Window system, preparation of Secondary School Leaving Certificate and Child Census. These aberrations necessitated installation of unlicensed versions of operating system and software in schools, in contravention of the state government policy (Free Software Foundation of India, 2008).

The table below gives a brief description of the objectives and relevant details of the IT@School Project.

The 2nd phase 'ICT Enabled Education' started in 2010 on 'close to completion' of the first phase 'IT Education'. Students' performance in competitions like painting using computers, and creating multimedia presentations, conducted regularly at local, district and state levels improved. Students who have computers at home started installing Free Software and contributing to localized content development. 'SchoolWiki', a customized version of Wiki provides a comprehensive knowledge database of all schools in the State, and includes collaborative content from student and teacher groups. Educational free software such as Dr. Geo, Rasmol, K-Tech lab, Geogebra, Chemtool, Kalzium are customised in developing teacher friendly applications to facilitate ICT enabled education. Apart from these initiatives, the project also started an interactive television programme in association with the ISRO and the Centre for Development of Imaging Technology (C-DIT) in Kerala, through which students and teachers in several schools in the State could interact with an expert at the studio in the headquarters. Known as ViCTERS (Virtual Class Technology on Edusat for Rural Schools), this has also become a regular television channel where a number of programmes related to school education are being telecast and made available on the internet [28]. Schools are now being given video equipments and video editing software, and students are encouraged to make video programmes including short movies and animations.

The school education system in Kerala is now being adopted at the national level where social constructivism and IT Enabled Education are being promoted. Though Free Software is not mentioned as such, the ideas of sharing and co-operation among students and teachers in the process of knowledge construction are emphasised in the national policy and by NCERT. The ICT draft National Policy in School Education stipulates that freeware and FOSS applications would be preferred [**?**]. The Times of India reports that the Gujarat government, following the Kerala IT@SchoolPproject model,

Objectives	Capacity building, infrastructure deployment at schools, content development, and delivery mechanism and satellite based learning system.
Phases	Phase 1 IT education (teaching software & hardware aspects, and programming). Phase 2 IT Enabled Education provides Instructor with freedom and flexibility to adapt IT in enhancing the delivery of their own courses and to increase learning effectiveness. Phase 3 ICT embedded education where all education delivery is done based on IT - with multiple touch points ranging from classroom technologies to instructional design and delivery.
Beneficiaries	The Project is now being implemented from 5th to 12th Standards in the State covering as many as 8,000 schools. An estimated 5 million students and 0.2 million teachers are now part of this project who have benefited from ICT enabled education.
Infrastructure	Development of own Operating System IT@School GNU/Linux- used in all the schools in Kerala. Broadband connectivity to almost all the schools in the State. Digital Super Highway connecting schools in the State is being initiated.
Training	Following a cascade model, focused on developing in-house capabilities by transforming the existing school teachers in various subjects to provide IT education. So far the Project has trained over 0.12 million teachers of the State till 2009 and in 2009 a total of 14,546 teachers were given specific training in ICT, especially for Physics and Chemistry. Provided Internet training to teachers. Selected teachers were trained in video production for VICTERS channel. Short term training provided to Student IT Co-ordinators and members of School IT clubs.
Hardware	Provided schools across the State with 50,000 computers. Supplied laptops and netbooks to teachers for use in classrooms. Set up Hardware Clinics for the maintenance and repair of damaged computers in schools. Intensive hardware training given to teachers boosting their confidence to such a level that they are able to handle most of the common technical problems.
Software	Functions on Free Software platform since it provides the freedom to an individual to study, copy, modify and re-distribute any content, a process which would ultimately benefit the whole society. Several educational software like Dr. Geo, Rasmol, K-Tech lab, Geogebra, Chemtool, Kalzium etc are being extensively customised by the Project in developing teacher friendly applications for facilitating complete ICT enabled education in the State.
Teaching materials	E-text books, Teachers & students ICT handbook, interactive CDs produced and distributed. Content development for educational programmes on VICTERS tv channel [also available on http://www.victers.itschool.gov.in/]. The Project is also associated with Intel's 'Skoool' for collaborative content development programmes (http://kerala.skoool.in).
Management	State-wide teacher network of 150 Master Trainers and 5,600 School IT Coordinators.
Expenditure	Significant savings by adopting free software - estimated to be 2.5 Million US$ a year (T.A.Pai Management Institute, 2010).
Pedagogical dynamics	The Impact Study conducted by T.A. Pai Management Institute did not find many cases of effective ICT use in pedagogy (T.A.Pai Management Institute, 2010).
Relationships with the outside world	Students contribute to www.schoolwiki.in
Rate of software piracy	During the pre FOSS phase Kerala School Teachers Association (KSTA) conducted a study on IT@School Project, which pointed out that 60% schools used illegal versions of software and 43% of heads of institutions were unaware of software licencing issues. No software piracy evidenced since the introduction of FOSS (SPACE, 2009).
Digital divide	By providing infrastructure and access to students, laudable attempt made to bridge the gap.
Public Action	Decision to adopt FOSS as a result of demands from FOSS activists and Kerala Teachers Association.
e-Governance	IT@School Project has implemented a number of e-Governance initiatives for the General Education Department of the Government of Kerala - Single Window admission system for Plus One admissions, Noon meal distribution computerization, part of the State level Secondary School Leaving Certificate (SSLC) examination work, Total Physical Fitness Programme software etc. The envisaged Digital Super Highway is expected to transform the Education Department to a paperless office.

had decided to use only Linux operating system and FOSS in the computers installed in 3,650 schools on an experimental basis, and if found successful, FOSS would be implemented in all the schools in the State. [26]. The Tamil Nadu government is seeking consultancy support of IT@School Project for implementation of IT enabled education in the State [21].

Kerala has now extended IT education to lower classes, down to class V, and is moving towards IT enabled education in higher classes. Kerala is the only province in any country in the world to migrate entirely to Free Software in school education. Comparing the Integrated Model implemented in Kerala, as against the BOOT model (Build, Own, Operate, Transfer) followed in other Indian states, Gurumurthy systematically establishes that the Kerala model is superior (Gurumurthy, 2009). In Kerala, it is the education department, and not the vendor that owns and manages the project unlike in other States. Computer installation, teachers training, maintenance and upgrade, software upgrades, are all the responsibility and come under the purview of the teaching community, and not a vendor.

The impact of IT@School Project has been assessed as 'very high' in Learner Capabilities Enhancement, Infrastructure Creation for IT Education and creation of Organisational Structure to support faster implementation [19]. The Project has received recognition at the Stockholm Challenge as it looks forward to progressing towards the final phase of IT Embedded Learning [17].

III. DISCUSSION

Not since the industrial revolution has any technology fundamentally changed the way ICTs have, by breaking down barriers of time and distance, bringing down costs, improving efficiency, augmenting innovation and expediting globalization. ICT has changed every sphere of economic, social and political activity. In the current globally networked society of e-Business, social networks and e-Governance, both human (that goes much beyond e-literacy) and institutional capacity building (that goes much beyond access) are as equally important as building physical capacity for any society to participate effectively.

The IT policy document 2007 of the Government of Kerala reflects this necessity [6]. Driven by an ideological realization that Free Software presents a unique opportunity in building a truly egalitarian society, the IT policy document 2007 commits to take all efforts to develop Free Software and Free Knowledge and to encourage and mandate the appropriate use of Free Software in all ICT initiatives. This document is the outcome of a comprehensive view of ICT as a vehicle for transforming Kerala into a knowledge-based, economically vibrant, democratic and inclusive society. By the term 'inclusive', the Government means that the benefits of the socio-economic transformation possible through ICT should reach every single citizen of the State. As part of this commitment, the government is already making publicly funded compilations of knowledge (such as a local language encyclopaedia funded by the government) freely available to the public through their web site as well as contributing it to Wikipedia. For ensuring ICT access to every citizen, the government aims to strengthen the already existing Akshaya, IT@School and FRIENDS Projects and Citizen Call Centres. By providing IT education at school level through IT@School Project, and by imparting e-literacy, and providing access through Akshaya centres, Kerala State is ensuring that the digital divide is addressed and e-Governance becomes effective and accessible to the citizens.

Digital Divide, Raj Reddy et.al, rightly observe, consists of many subdivisions like Infrastructure Divide, Access Divide, Literacy Divide, Language Divide, Information and Knowledge Access Divide, Jobs Divide, Health-care Divide, Entertainment Divide and Demographic Divide [15]. Unlike the other Indian States, Kerala with its total literacy and aspiration for education, would find it easier to bridge the divide by providing infrastructure, and training the community to be e-literate. When infrastructure is provided, access ensured, and e-transactions and e-communication made possible in the local language as well, most of the other divides will get automatically reduced. Adoption of FOSS provides financial savings and freedom to tailor to the needs of specific populations. These two aspects consistently help bridge the divide.

Empirical evidence shows that FOSS contributes to mutual and collaborative learning in an educational environment. The possibilities of extensive customization of software supports local needs better, and allows users to participate more proactively in the development and implementation of Free/Libre Open Source Software (FLOSS) systems [11]. In their study of implementation of FLOSS in an Italian school, Lin and Zini found that FLOSS significantly reduced the management costs of ICT systems like licencing fees of proprietary software, the cost for periodical update to fix vulnerability, and the cost of improvement of capability. The resultant savings on licence fee was invested in updating infrastructure and acquiring new hardware and know-how. The rate of piracy was nil. The openly available source code enabled software customisation. The philosophy of FLOSS movement, when employed in daily teaching and learning, resulted in pedagogical dynamics, and instead of teachers providing authoritative teaching/learning materials, students could be involved in producing teaching and learning materials (e.g. contributions to Wikipedia) and students and teachers could share views via weblog etc. The relationship with the outside world increased, and students collaborated to contribute to FLOSS projects, share experience with students from other schools, and started web authoring. Digital literacy improved, and students were able to adjust to a variety of different applications to complete tasks. Secondary materials available on IT@School Project show similar results with one major exception. The Impact Study conducted by T.A. Pai Management Institute did not find many cases of effective ICT use in pedagogy.

IV. CONCLUSION

Kerala, a small province in the south-western coast of India has been constantly endeavouring to improve its school ed-

ucation system to achieve the objective of making its people better equipped to face the challenges of a modern society. Possibly as a consequence of the State giving education a high priority in its plans for quite some time now, we find people from Kerala employed in various professions in all parts of the world. The decision of the State government to embrace IT Enabled Education using Free Software has to be seen in this background. In this also, as in earlier instances, Kerala is being perceived as a 'model' for the rest of the country. This prompted the government of India to mention in its education policy the desirability of introducing IT education in schools and eventually moving to IT Enabled Education, mentioning the desirability of using FOSS for the purpose.

The way in which Kerala has adopted Free Software and IT education has been much appreciated by those who have studied the process. However, the success of the process in terms of achieving its objectives and the extent to which the school system has succeeded in making use of IT for classroom transactions remain to be properly evaluated. For instance, while all current students completing high school learn to use a computer with GNU/Linux and they have to go through a State-wide examination at the end of their tenth class, the extent to which they acquire the necessary skills has not been objectively evaluated. While the students use Free Software, and the ideas of Free Software are mentioned in the textbooks, it is not clear whether they have really understood these ideas. It is even possible that many teachers too are yet to comprehend the philosophy of Free Software or its significance to schools in particular and to society at large. Similarly, it is yet to be evaluated how teachers use IT effectively in their classroom transactions. However, we believe that the innovative experiment happening in Kerala has important lessons for both the developing and the developed regions. But a clearer understanding demands further studies on the process and its achievements.

The project supports the ideologues envisaged in the domain of free software—one that positions the writing of source code as free speech, juxtaposed against traditional forms of intellectual property, considered a form of self-censorship (Mcgowan, et al., 2007). Though public action has contributed to the adoption of FOSS in school education of Kerala, the GOK played a significant role in the adoption and institutionalization in replacing 'mainstream' (proprietary) software in government establishments, especially education. How would this impact on the 'radicalism' of FOSS movement in Kerala? With the adoption at the school level, there is a possibility that FOSS would have a critical mass to ensure that further adoption becomes sustainable. However, in the alternating political coalition rule in Kerala, what would happen if and when a ruling coalition withdraws support for FOSS? Alternating regimes is a vital issue: can governments frame education technology policy in this context especially when it concerns young learners, who'll be orphaned by a rollback? In the students' interests, will the FOSS advocates and activists be able to extract a commitment from govern-

ments to policy continuance? Only time will tell.

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