Teacher Professional Learning Communities: a collaborative OER adoption approach in Karnataka, India

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1 Abbreviations and glossary of terms

1. Table: Abbreviations and glossary of terms

Term	Explanation
Academic year	In Karnataka, the academic year is from June of the current year to May of the following year.
Block / Taluka	The unit of education administration, below the district
COA	Collaborative OER Adoption.
COA group	A group of 67 teachers, who have been part of the COA processes, along with members of IT for Change research team.
CCE	Continuous and Comprehensive Evaluation, a new method of learner assessment introduced in India, mandated by the Indian Right to Education Act, 2009. This approach stresses formative assessment (assessment for learning and assessment as learning), complementing the traditional summative assessment (assessment of learning)
Comparable group	A group of teachers who are similar (demographically and in professional parameters) with the COA group of teachers.
DIET	District Institute of Education and Training, the apex academic institution at district level for syllabus, curriculum and teacher training. India has around 683 DIETs and Karnataka has 34 DIETs.
District	Administration unit for education system, below the level of the state (provincial) administration
DSERT	Directorate of School Educational, Research and Training (http://dsert.kar.nic.in) the apex academic institution at state level for syllabus and curriculum development, as well as teacher training.
FOSS	Free and Open Source Software, also known as 'open source' software or 'free software'
FGD(s)	Focus Group discussion(s)
ICT	Information and Communication Technologies (more specifically digital technologies)
ICT@Schools	Programme of state governments in India, to introduce ICT in high schools
ITfC	IT for Change
KOER	Karnataka Open Educational Resources. Refers to the programme of the Karnataka education department in which OER was collaboratively created by a group of teachers, in mathematics, science and social science. KOER also refers to the websites in English and in Kannada, in which the OER created by these teachers was uploaded.
OER adoption	OER adoption is used throughout the report in a comprehensive manner, to include resource reuse, creation, revision, remixing and redistribution. This definition is in line with the ROER4D "Research Concepts Note", where 'adoption' is used to include resource reuse, creation, revision, remixing and redistribution.
OER processes	In this report, OER processes refer to the processes of accessing, creating, revising and sharing resources.
Mailing lists / Mailing groups	Google Groups created in subject categories in the STF program, for all teachers trained. Two groups are relevant to SP5: Mathematics and Science teachers mailing list (accessible on

	https://groups.google.com/forum/#!forum/mathssciencestf) and Social Science teachers mailing list (accessible on https://groups.google.com/forum/#!forum/socialsciencestf). Appendix D provides a list of the mailing groups
NCERT	National Council for Education Research and Training
NGO	Non-governmental organization
PLC	Professional Learning Community. Specifically refers to the Subject Teacher Forums created by the STF (see STF) programme. These forums primarily interact on the mailing lists, created in subject categories (see 'Mailing list'), and are large and state-wide.
Public school / education system	The government school system in Karnataka, in this report, specifically that part catering to secondary education. The Education Department of the Government of Karnataka runs around 4,500 high schools across the state.
RMSA	Rashtriya Madhyamika Shiksha Abhiyaan, (see http://mhrd.gov.in/rashtriya_madhyamik_shiksha_abhiyan) the programme of the Ministry of Human Resource Development, Government of India (see http://mhrd.gov.in), for supporting secondary education.
SP5	Sub-Project 5 of the Research on Open Educational Resources for Development (ROER4D) project (information about SP5 is accessible on the ROER4D project website at http://roer4d.org/collaborative-creation-of-oer)
State	India has a federal set-up. The Union or Federal government is also referred to as the Central Government. The provincial governments are usually referred to as 'state' governments.
STF	Subject Teacher Forum programme
TPD	Teacher Professional Development

2 Abstract

Public school systems in India face a serious problem of limited curricular resources. The textbook supplied by the state government, through the department of school education, for each subject, is usually the sole resource at a teacher's disposal. This aligns with the education bureaucracy seeing the teacher as a "minor technician" (Scheffler, 1973),[1] whose job is to merely transact the content of the prescribed textbook, rather than use multiple resources to explore the topic in a deeper and broader manner with students.

Open Educational Resources (OER) can potentially enrich a learning environment of this kind; however, there are several challenges to adoption, including poor availability of ICT infrastructure, limited competency on the part of teachers to use digital technologies in the classroom and lack of OER in the local languages, which form the medium of instructions in public schools.

A collaborative OER adoption programme which included 67 mathematics, science and social science high school teachers and teacher educators in Karnataka state, India, was studied using an Action Research approach. This group was embedded within a larger professional learning community (PLC) of around 12,800 teachers across Karnataka, developed through the Subject Teacher Forum (STF), an in-service teacher education programme in the public school system in Karnataka.

The mixed-methods research approach included 19 workshops with the 67 teachers and teacher educators where they participated in collaborative OER adoption processes. The effectiveness of this model of OER adoption was studied through structured questionnaires and focus group discussions, a review of mails shared via the PLC's mailing lists, and review of content created on the Karnataka Open Educational Resources[2] (KOER) repository. Based on interviews with key actors, the systemic factors that enabled and constrained collaborative resource adoption have been analysed. Data analysis suggests that teachers are able to use digital methods to adopt OER, and to contextualise OER to their needs. The OER processes have aided teacher professional development by building a collaborative environment with peers and introducing them to multiplicity of educational resources.

The collaborative resource adoption model has been acknowledged as a national best practice by a review mission[3] of the Government of India. Other state governments[4] have expressed an interest in adapting this model in their own in-service teacher education programmes.

Keywords: **OER, participatory, systemic, professional learning community, teacher professional development, FOSS**

1 Scheffler (1973, page 61) writes that: "The transmission model of education coupled with the drive for increased efficiency tends to foster the view of the teacher as a minor technician within an industrial process". Policy makers' and bureaucrats often tend to see teaching as a process of transmitting content to students and the teacher's role as a transmitter of this content.

2 A MediaWiki based platform for sharing the content created in English and Kannada languages by the teachers, see http://karnatakaeducation.org.in/KOER/en/index.php and http://karnatakaeducation.org.in/KOER for the English and Kannada websites respectively

3 Joint Review Mission (JRM) of the federal Ministry of Human Resource Development, which is responsible for education. The report is available at http://mhrd.gov.in/rmsa_jrm, see http://mhrd.gov.in/sites/upload_files/mhrd/files/upload_document/3rd%20Jrm%20Aide%20Memmiore.pdf

4 Including Telangana and Assam state governments.

3 Introduction

3.1 Rationale

Public school systems in India face a serious challenge of limited curricular resources. The textbook supplied by the state government, through the department of school education, for each subject, is usually the sole resource at a teacher's disposal. This emphasis on the textbook is reinforced by the limited availability of alternative resources. Open Educational Resources (OER) can potentially enrich a learning environment of this kind. However, while OER proponents often assume that availability of free, good quality learning materials is sufficient for OER adoption, the usage of open educational content in developing countries is relatively low (Hatakka, 2009). This study proposes to study OER adoption in a developing country context, through an action research, in the public school system of Karnataka state in India.

In India, education is a 'concurrent' subject, meaning both the central and state governments have a role in policy making and administering education in the country, with the central government providing the basic policy framework and supplementary funding. In many ways, the education context in Karnataka is similar to that in rest of the country, and this chapter discusses the education system in Karnataka and India, as a background to the study.

3.2 The Indian education context

India has more than 1.6 million schools, of which more than 70% are public (meaning government[5]) schools (District Information on School Education, 2013-14[6]). These government schools typically cater to children from the most marginalized sections of Indian society, since they offer free tuition as well as a range of support services such as free textbooks, free school uniforms, lunch, bicycles and scholarships. Government schools do, however, face serious challenges in terms of the quality of education offered. As the "Annual Status of Education Report" study conducted across India by the NGO Pratham, states, an unacceptably large percentage of children are unable to do even basic reading, writing and arithmetic operations. The study report, accessible at http://www.asercentre.org, also claims that around 70% of children do not pass Class 10, and many of those who do, lack basic life skills and competencies.

Some reasons for the poor quality of learning in India are socio-cultural; focus on universal school received serious attention in India after the "National policy on Education, 1986". India has the largest population of illiterate adults in the world[7] and hence, many of the children who are currently attending school are "first generation school goers" who receive little or no support at home. Other reasons impacting the quality of learning are pedagogical and structural such as limited availability of curricular resources (Kanwar, Kodhandaraman & Umar, 2010), inadequate school infrastructure and inadequate teacher professional development processes (see for instance PROBE report, 1998), all of which create an impoverished learning environment.

3.2.1 Indian and Karnataka education system

India has a federal government set-up, with the federal government, (aka Central Government) at the national level and provincial governments (aka state governments) for each of the 29 states in the country. The Indian

5 Public schools are used synonymously with government schools in this document

6 This is an annual compilation of information from all schools, by the MHRD (Ministry of Human Resources Development), Government of India

7 See UNESCO. 2014 Education for All Global Monitoring Report (GMR), accessible from http://en.unesco.org/gem-report/allreports

education system has institutions set up at the central, state, district and block[8] levels to support schools. Education is a 'concurrent' subject, meaning both the central (federal) and state (provincial) governments can legislate and implement education policy and programmes. However, in practice, the central government role is restricted to macro policy aspects including curricular frameworks, and actual implementation is left to state governments. Karnataka is one of the 29 states[9] in India.

At the central government, the Ministry of Human Resources Development (MHRD) is responsible for education. MHRD has different departments responsible for school education, higher education etc., which work with their corresponding departments in the state governments. Karnataka is one of the 29 states in India. The education structure in Karnataka is similar to other states, it has a department of education, which has structures/institutions at the state, district and block levels. Table 2 gives an overview of the education administration in India.

2. Table: Indian education system - a tabular depiction

Level of administration	**Name of the governing authority**	**Number of institutions in India**	**Number in Karnataka**
National / Federal / Central	Ministry of Human Resource Development, Government of India	1	NA
State / Provincial	Department of School Education, Government of Karnataka	29	1
District	District Institute of Education and Training (DIET) (administrative unit within a state)	Around 683[10]	30
Block / Taluka	Block Education Office (administrative unit within a district)	Around 6,000	176

Source: Elementary Education Report Card 2014-15. DISE

Academic support institutions are distinct from education administration institutions at each of these levels, which requires high levels of collaboration amongst them, for coherent functioning. The size and complexity of the system makes coordination amongst the actors (teachers, teacher educators and education administrators) quite difficult and this has an influence on its functioning (Table 2). Table 3 provides information on the number of schools, teachers and students in India and Karnataka. CITE

3. Table : Number of teachers, schools and students (Karnataka state relative to Indian school system)

Statistics	**India**			**Karnataka state**		
Number of	**Government**	**Private**	**Total**	**Government**	**Private**	**Total**
Schools	1,180,622	498,645	1,679,324	50,934	25,780	76,714
Teachers	5,349,263	4,047,655	9,155,931	226,148	197,129	422,474
Students	135,887,920	100,080,588	235,968,508	5,065,175	5,047,563	10,112,738

Source: For elementary education in India: Elementary Education Report Card 2014-15. DISE. http://dise.in/Downloads/Elementary-STRC-2014-15/All-India.pdf

8 The district is the unit of general and education administration below the state, and below the district is the block also known as ‘taluka’

9 We will use the term ‘state’ to refer to the province of Karnataka, as per the practice in India

10 See en.wikipedia.org/wiki/List_of_districts_of_India

For secondary education: Secondary Education : Flash Statistics: 2014-15. DISE.
http://dise.in/Downloads/Publications/Documents/SecondaryFlash%20Statistics-2014-15.pdf

3.2.2 Linguistic diversity

India is organized into states based on the language spoken, and the Indian school system is also linguistically diverse. Typically, each state has one main language, spoken by the majority or at least by a large percentage of its population. Invariably many people in the border districts of any state speak the major language of the neighboring state. Indian education policy (The "Right of Children to Free and Compulsory Education Act", 2009) requires that the state offer education, with the first language of the learner as the medium of instruction. The state education system typically offers instruction in at least two languages; the official state language and English[11]. In the border areas, schools offer the language of the neighboring state as a medium of instruction as well.

In Karnataka, apart from Kannada (the state language of Karnataka) and English, government schools offer Urdu, Telugu, Tamil and Marathi languages as medium of instruction; these are languages spoken in Telangana[12], Andhra Pradesh, Tamil Nadu and Maharashtra respectively bordering Karnataka state. The 2001 census of India[13] indicates that 13 languages are spoken by more than 10 million native speakers, 30 languages are spoken by more than a million native speakers, and 122 are spoken by more than 10,000 people in the country. The multilingual nature of Indian society (and of the Indian education system) therefore provides a compelling context for OER adoption[14] in multiple languages. The linguistic diversity of India can be seen depicted graphically on http://ceevrc.org/CODE/Catalogue/resources.asp.

This research attempts to understand OER adoption within the public education system in Karnataka in terms of techno-social, techno-pedagogical, and socio-cultural factors

3.3 Techno-social factors

The term 'techno' in this context, refers to digital technologies, in terms of infrastructure, devices, connectivity and software. Digital technologies are embedded within the social contexts of their use. The design and direction / focus of digital technologies is influenced by the social contexts in which they are utilised; at the same time, digital technologies also influence social contexts. Vespignani (2009, p. 425) states: "We live in an increasingly interconnected world of techno-social systems, in which infrastructures composed of different technological layers are inter-operating within the social component that drives their use and development" (p. 425). The term "techno-social" in this study context, refers to inter-relationship between digital technologies and teachers use thereof in OER adoption, within the Karnataka public education system.

Reports from the International Telecommunications Union (ITU), the UN body responsible for global communications, reveal the poor availability of ICTs) in the Global South, in terms of physical access to ICT infrastructure, capacity building for access, as well as maintenance of ICT infrastructure to enable continued access. The "Individuals using the internet 2005 to 2014" report (available on http://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2014/ITU_Key_2005-2014_ICT_data.xls) suggests that there is a big gap between developed and developing countries with regard to key ICT indicators. The availability of digital

11 There is a lot of pressure from parents on the state government to offer 'English medium' instruction

12 Urdu and Telugu are major languages spoken in Telangana, Telugu in Andhra Pradesh

13 see http://www.censusindia.gov.in/Census_Data_2001/Census_Data_Online/Language/gen_note.html

14 As discussed in the ROER4D "Research Concepts Note, the term "adoption" is used in a comprehensive manner, and includes resource reuse, creation, revision, remixing and redistribution. The document is available at https://docs.google.com/document/d/1Iz1kVC4CYLFJBtZNm2o5ziFJKW96SjtNjhWHfTKKkbI/edit

technologies is poor in Indian households and in schools; the lack of ICT infrastructure is a defining feature of the Indian education system as well. (Thakur. 2014). The poor access to ICT would impact access to OER, as OER is mostly digital in nature. In the absence of basic ICT infrastructure, people will not be able to access OER, hence the 'free availability' of OER is just notional.

3.3.1 Outsourced model of ICT implementation

The 'ICT@Schools' programme of the Government of India (details are available on the programme website http://ictschools.gov.in/Policy/national-policy-ict-school-education-2012) aims to provide ICT infrastructure to all high schools in the country. The implementation of this has been programme has been outsourced to vendors in most states, including Karnataka. In the outsourced model, the programme is implemented and managed by a private entity, which supplies the computers, sets up the lab, appoints and manages the computer faculty and provides the content for the ICT classes. Unlike other states, Kerala chose to implement the ICT programme through the teachers in the education system.

A study by Kasinathan, comparing the outsourced model implemented in Karnataka with the integrated model of Kerala, suggests the outsourced programmebypasses regular teachers, creates dependence on technology vendors to provide basic ICT literacy to students and has led to poor ICT uptake. (Kasinathan, 2009). This outsourcing is based on the perceived inability or unwillingness of teachers to learn to use ICTs and integrate them into their teaching. With the content being developed in a stand-alone manner without any reference to the school curriculum, teachers have largely seen ICTs as irrelevant and the ICT infrastructure provided by the programme is often grossly under-utilised (Kasinathan, 2009).

The outsourced model of implementation is now widely being regarded as a failure and state governments are open to exploring alternative models where ICT education is delivered by regular teachers. A study by the Central Institute of Educational Technology (CIET) suggests that use of ICTs may not simply follow its provisioning. ICT integration processes therefore need to be carefully designed in order to encourage teacher use and participation. (Central Institute of Education Technology, 2015).

3.3.2 Proprietary environment

A further limitation was the use of proprietary software (limited mostly to Office applications) for the content of the programme (Kasinathan, 2009), in the outsourced model. Without many possibilities for developing subject based content, teachers' creation of digital resources was rare as there was limited or no access to tools for resource creation. (In Kerala, the programmewas implemented using free and open source software applications). In response to this, India's "National Policy on Information and Communication Technology in School Education" (Government of India, 2012) has recommended the establishment of a free and open technology environment in tools and envisions teachers to participate in the creation of digital resources.

This research attempts to study if a free and open technology environment, where teachers collaborate in OER adoption, can support teacher development and OER adoption.

3.4 Techno-pedagogical factors

"Techno-pedagogy" here refers to the integration of digital methods in educational processes. Mishra and Koehler (2006) suggest that knowledge of digital technologies influences, and is influenced by teaching processes. The interactions between digital technologies and pedagogical processes can be termed as "techno-pedagogical". The research is concerned with two aspects – the availability and use of curricular resources in teaching and teachers' networking for their professional development. OER is digital by nature,

hence techno-pedagogical knowledge may have the potential to influence OER adoption in the Indian education system.

3.4.1 Curricular resources and OER

Content and process (curriculum and pedagogy) are generally acknowledged as the two intertwined components of learning. Eisner (1991, page 11) states: "Like the systole and diastole of the beating heart, curriculum and teaching are the most fundamental aspects… No curriculum teaches itself, it always must be mediated, and teaching is the fundamental mediator". India, however, has what has been termed a "textbook culture" (Kumar, 1988), in that the textbook is seen as the single, definitive resource for teaching. In his *Origins of India's "textbook culture*", Kumar (1998) writes:

> The second type of education system ties the teacher to the prescribed textbook. She is given no choice in the organization of curriculum, pacing, and the mode of final assessment. Textbooks are prescribed for each subject, and the teacher is expected to elucidate the text, lesson by lesson in the given order. She must ensure that children are able to write answers to questions based on any lesson in the textbook without seeing the text, for this is what they will have to do in the examination when they face one. The Indian education system is of the second type. (p. 452)

The textbook culture emphasizes the state-published textbook as the vehicle of education, thereby "serving as a means through which the bureaucratic authority exercises its influence; it becomes the symbolic hub of the power structure that governs the teacher's daily routine" (Kumar, 1988, p. 453).

The Department of Education in most states supplies textbooks for all subjects free of cost to all teachers and students. This emphasis on the textbook is reinforced by the limited availability of alternative resources. Consequently, many teachers mostly use only the textbook, than additional resources, in their teaching. This practice informs teachers' perceptions of their role as that of a being a "'minor technician" (Scheffler, 1973), merely utilising the resources and approaches made available through government channels. Scheffler (1973) writes:

> The transmission model of education coupled with the drive for increased efficiency tends to foster the view of the teacher as a minor technician within an industrial process. The overall goals are set in advance in terms of national needs, the curricular materials pre-packaged by the disciplinary experts, the methods developed by the educational engineers, and the teachers job is just to supervise the last operational stage – the methodical insertion of pre-ordered facts into the students mind. (p. 61)

Such a 'content transmitter' perspective can influence teachers in limiting their engagement with additional or alternate curricular resources and teaching methods.

Secondly, providing the same text book for each subject and class[15] to all schools across the state fails to meet diverse learning needs of a large country. In recognition of this challenge, the National Curriculum Framework for school education (2005), developed by the National Council of Educational Research and Training, has emphasised the role of technology-mediated teacher development and resource-creation processes in contributing to an inclusive and contextually appropriate learning resource environment.

15 The same text book is produced in each language, which is a medium of instruction in the schools. For instance in Karnataka, the mathematics text book for a class is produced in six languages, which serve as medium of instruction in different schools of the state. This of course does not apply to the text books for the 'language' subjects, such as English or Hindi or Kannada.

Collaborative processes of teacher resource creation can support teachers to collectively resist the notion of the 'minor technician'.

3.4.2 Teacher networking for professional development

In India, the provision of school within or close to every habitation is a policy requirement. The Sarva Shikshana Abhiyaan[16] (Sarva Shiksha Abhiyaan, 2008, 2008) programmeof the central government, adopted by all provincial governments requires a lower primary education (grades 1 to 5), and upper primary school (grades 6 to 8) within 3km within 1km of every habitation. This causes the public school system to be vast and dispersed.

Teachers seldom have contact with their peers in other schools or with other educational institutions. Training tends to be transactional. It has been recommended that spaces for sharing of experiences should be an important principle of in-service teacher education[17]. In a survey of 196 elementary and secondary education teachers attending graduate programs in the University of Central Florida's College of Education, Rothberg (1985) found that over 80 % of teachers felt their classrooms were private worlds entered only by themselves and their students. Teachers in this study reported that formal and informal visits to their classrooms by observers or evaluators were rare, as were their own visits to the classrooms of other teachers. Teacher isolation thus appears to be no isolated phenomena.

There is therefore a need to study how a technology enabled professional learning community (PLC) , where teachers can network virtually, can support OER adoption and teacher development by reducing teacher isolation and enabling peer learning. *In what ways can collaborative, "bottom-up" approaches by teachers working together to adopt resources provide an effective OER adoption model? Does such collaboration influence TPD and teaching practices?*

3.5 Socio-cultural factors

The "global" OER movement is located predominantly in the geo-political North and most OER programmes as well as OER portals for accessing resources are located in Northern institutions. Given that educational systems in the North may be more advanced in terms of institutional maturity, as well as in their methods and processes of curricular resource design and development, their resources may *prima facie* appear superior. However, adoption of these resources can pose a risk in terms of ignoring the local learning contexts, strategies and abilities of learners. OER adoption of this kind also stands to further strengthen the hegemony of the North in the global educational sphere by expanding the diffusion and reach of Northern resources. If OER is to be explored as a key mechanism for addressing education needs, it is important to understand whether and how OER models that are developed within the Global South can more effectively address learners' needs in contextually appropriate ways. Given its linguistic and cultural diversity, this issue of inadequate contextually appropriate resources, particularly affects India.

3.5.1 Local language and culture

Most OER are developed and available in the English language, with a far smaller percentage available in the local languages of the learners, in India. For instance, if we consider Wikipedia, which is the most popular OER site in the world (Alexa rankings, 2016, retrieved from https://en.wikipedia.org/wiki/List_of_most_popular_websites), the Kannada Wikipedia (Kannada being the local language in the state of Karnataka) has around 20,000 pages, in contrast to the over five million pages

16 Means "programme for universal education"

17 National Curriculum Framework for Teacher Education, 2009

in English.[18] This is one example of the relative paucity of OER in Indian languages, relative to English.

Albright (2005) states:

> OER are cultural as much as educational, in that they give users "an insight into culture-specific methods and approaches to teaching and learning" - a practical exposure to the way that courses are "done" in another country or by another instructor. Language is clearly intertwined with culture in this dynamic. The vast majority of Open Educational Resources are in English, which is spoken by perhaps 10 per cent of the world's 6.3 billion people. Not only does the English language dominate OER provision, but English-language content tends to be based on Western learning theory. This limits the relevance and accessibility of OER materials in non-English, non-Western settings. There is a risk that language barriers and cultural differences could consign less developed countries to the role of OER consumers rather than contributors to the expansion of knowledge. (p. 12)

There is therefore a need to study how bottom up OER adoption processes with teachers can aid the design and development of OER that are more relevant to local contexts.

Techno-social, techno-pedagogical, and socio-cultural factors are not to be viewed as silos, exclusive of one another, and there may be areas of overlap between them. For instance, teacher networking can be viewed both as part of techno-pedagogical factors (in the context of peer learning) or as socio-cultural factors (impacting upon teacher isolation).

As seen from the discussions above, the current techno-social (limited capacities of teachers to work with ICTs, lack of a free and open technology environment), techno-pedagogical (text book culture and teacher isolation) and socio-cultural (lack of OER meeting local needs) contexts in Indian education have largely not been conducive to the adoption of OER in the Indian public education system. It was found necessary to study how a programme of teacher capacity building to enable teachers to collaborate to access, create, revise and share OER can influence the

1. techno-social (use of digital methods, free and open technology environment),
2. techno-pedagogical (creation and use of curricular resources, teacher networking), and
3. socio-cultural (use of materials in local languages and reflecting local culture) factors with regard to OER adoption.

3.6 Background to the research

3.6.1 Subject Teacher Forum (STF) - Professional Learning Community

The Subject Teacher Forum (STF) programme is an in-service TPD initiative designed and implemented by the Directorate of School Educational Research and Training[19] (DSERT) under the Rashtriya Madhyamika Shiksha Abhiyaan (RMSA)[20] scheme, in collaboration with IT for Change (ITfC), the organisational host of this ROER4D sub-project.

The STF was implemented from June 2011 and its primary purpose is teacher professional development, using a technology enabled professional learning communities (PLCs) approach. An important aim of the

18 See https://en.wikipedia.org/wiki/List_of_Wikipedias

19 DSERT is part of the education department of the Government of Karnataka. (See http://DSERT.Kar.nic.in)

20 RMSA is a nationwide programme run by the Government of India to support secondary education.

STF is to enable teachers to utilise ICTs for networking with one another and to support peer learning. Besides training teachers in digital methods, the STF programme created subject-oriented PLCs where teachers interacted with one another on mailing lists to share materials, ideas and experiences.

The PLC comprises around 12,800 mathematics, science and social science teachers from government high schools across Karnataka state, who interact through mailing lists to share experiences and resources.

3.6.2 KOER project – OER adoption

During the STF programme implementation, the paucity of contextual materials for high school teaching of mathematics, science and social science, that could complement and supplement the text books was noted by the teachers and by the DSERT and RMSA. This was an especially acute need felt by the teachers in view of the revision to the textbooks for classes 8, 9 and 10 that was carried out by DSERT during this period. Responding to this need, in July 2013, the DSERT began the Karnataka Open Educational Resources (KOER) project, in partnership with IT for Change, for a chosen subset of teachers 67 mathematics, science and social science teachers and teacher educators, who were a part of the STF PLC.

The aim of the KOER project was to support these 67 teachers to collaboratively create and adopt OER to develop supplementary and complementary digital resources for the recently revised textbooks. Traditionally curricular resource development had been centralized and digital content development has been outsourced. The bottom-up approach to resource creation in this project was an important departure from the traditional approach.

3.6.3 Sub-project 5 - Research

ITfC saw this as an opportunity for an action research program, in which along with the actual work of building teachers' capacities for OER adoption, ITfC could design and conduct research to study the influence of the programme on the techno-social, techno-pedagogical and socio-cultural factors that constrain and enable OER adoption in the Karnataka public school system.

3.7 Aim of the research

Sub-project 5 is an action research project with the 67 teachers who formed the Collaborative OER Adoption (COA) group. In the action research, ITfC has worked with the COA group, training them on digital literacy and collaborative OER adoption. ITfC designed and conducted workshops for the COA group of teachers, during the academic years 2013/14, 2014/15 and 2015/16. Through the action research, ITfC attempted to address the following research question:

Can a collaborative, "bottom-up" approach by teachers working together to create, adapt and share contextually appropriate resources provide a model of OER adoption?

The research studied the collaborative OER adoption by examining the enabling and constraining *techno-social, techno-pedagogical and socio-cultural* factors.

3.8 IT for Change

Established in 2000, IT for Change (ITfC) has been consistently working for the innovative and effective use of Information and Communication Technologies (ICTs) to promote socio-economic change in the Global South. Intervening at the levels of both discourse and action, ITfC has contested the dominant theories of Information Society from a standpoint of equity and social justice. ITfC engages in research, advocacy and field work in the thematic areas of Development and Information Society, Community Informatics, Technology Governance, Gender, Governance and Education. In this endeavour, ITfC has partnered with many regional, national and international institutions, activist groups and academics.

Education is an important domain of work for ITfC. ITfC conducts research on its own and others programs on integrating ICTs in education. ITfC has participated in action research as well as demonstration field projects. ITfC is also a part of curriculum design programs and policy related committees, at national and state levels. The researchers in this study are visiting faculty at the Tata Institute of Social Sciences, for the 'ICT and Education' course and for similar courses in other pre-service teacher education programs. The aim of ITfC is to study and build models of teacher development through integration of digital technologies, and to support government school systems to adapt the same, through policy advocacy and programmatic support. Sub-project 5 is part of the core mandate of the work of ITfC.

4 Literature Review

4.1 OER benefits, costs and challenges

OER are considered to have substantial economic benefit in terms of reducing the cost of accessing learning materials (Lane, 2008) and allowing for the distribution of materials at almost no cost to the user (Wiley, Green & Soares, 2012). By opening access to freely available, globally created resources, and enabling the revision and reuse of these materials through open licensing mechanisms, OER are also seen as having the potential to address existing quality gaps (Camilleri, Ehlers & Pawlowski, 2014). OER adoption and their potential to expand access to and improve the quality of education is one of the key emerging issues in educational discourse today, particularly as it relates to developing countries where there is a dearth of quality learning materials (Kanwar et al. 2010). While OER offers great potential in terms of addressing quality and access issues in education, "the real challenges facing readiness to adopt OER appear to be related to socio-economic, cultural, institutional and national issues" (Ngimwa & Wilson, 2012, p. 398).

These challenges need to be studied and addressed in order to enable OER adoption; particularly as there is currently a gap in reliable evidence arising from on-the-ground experiences to support the claims that OER can help countries in the Global South to address quality and cost challenges (Daniel & Uvalic-Trumbic (2012). Hatakka (2009, p. 1) comments that "OER initiatives are very commendable and needed ... open content is not being used by educational organizations in developing countries (or rather the usage of the free resources is low)". The actual adoption and use of available OER by institutions in the South appears to be limited.

This study seeks to understand the factors that influence the adoption of OER in the Indian context. It investigates the influence of collaborative resource creation and sharing processes on the techno-social, techno-pedagogical and socio-cultural factors of the Karnataka public school education system*!!br0ken!!* The literature review is discussed along these three factors.

4.2 Techno-social factors

Two factors are relevant here – firstly that OER is almost always digital in nature, hence to adopt OER, teachers need to learn digital literacy skills. Secondly, proprietary technology environments can influence the abilities of teachers to create and share OER.

4.2.1 OER is digital

Information is increasingly being created, stored and transferred in digital formats. In 2000, 75% of stored information was in an analogue format such as video cassettes, but by 2007, 94% of it was digital[21]. OER are typically made freely available on the internet (Kanwar et al., 2010) and the term has a strong technological (digital) connotation. Since OER are largely available in digital formats, teachers need to interact with the

21 http://www.bbc.co.uk/news/technology-12419672

digital environment, acquiring digital literacy skills to adopt OER.

4.2.2 Proprietary digital technologies - "consumer" or "creator"

Digital tools and resources are easy to share, but proprietisation imposes legal and technological barriers to sharing. We do not own proprietary digital tools, even when we "pay" for them, but can only obtain a licence for their use. Barriers to revision and re-distribution of these digital artefacts are high in the case of developing countries, as the cost of the software can be prohibitively expensive in large scale adoption in public education systems. (Kasinathan, 2009). OER production requires access to digital tools, and barriers to sharing digital tools can constrain OER production.

4.3 Techno-pedagogical factors - collaboration and quality of OER

It has been argued that the quality of teaching practices and the quality of learning outcomes can be improved by opening up OER adoption processes for formal peer-review or informal interrogation through conversations with colleagues (Petrides, Jimes, Middleton-Detzner & Howell, 2010).

Sapire and Reed (2011) in a South Africa study explored whether collaborative design and redesign of materials can enhance quality while containing time and resource costs, and whether such collaboration encourages buy-in to the use of OER as well as further redesign to accommodate the needs of particular teachers and students. They concluded that "collaborative redesigning of existing materials from a range of institutions offers one solution to these challenges" (2011, p. 209).

4.4 Socio-cultural factors

4.4.1 Contextual OER

"Meaning in context: is there any other kind?" asked Mishler (1979). Ferreira (2008) states:

> it is yet unclear what types of learning OER may afford outside their original context. Different aspects of academic practice are inscribed in the resources being made available by OER initiatives ... This is critical for the OER movement because re-use (by teachers and learners alike) requires a double move of de-contextualization and subsequent re-contextualization under circumstances often quite distinct from the original location of the resources. (p. 4)

Hence, it appears naive to assume that OER can seamlessly be adopted across cultures and contexts. Translation of materials created in another language elsewhere, will make these materials accessible to those who speak the languages translated into. However, mere translation may be inadequate, there is a need to re-contextualise the materials. Context-appropriate education is a challenge in a large and diverse country like India.

5 Methodology

This research adopts a mixed-methods methodology, in which Lead Researcher Gurumurthy Kasinathan and Researcher Sriranjani Ranganathan, along with other members of the ITfC research team, collaborated with 67 teachers and teacher educators on OER adoption. The ITfC team worked with the COA teachers, through a combination of physical workshops[22] and on-line interactions, between June 2013 - Dec 2015.

22 These workshops took place in the period between July 2013 and August 2015. A total of 19 workshops were held separately for Mathematics, Science and Social Science teachers in order to tailor the creation of resources by

An Action Research approach was considered most suitable for the study. As stated by Gilmore, Krantz and Ramirez (1986, page 161):

> Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to further the goals of Social Science simultaneously. Thus, there is a dual commitment in action research to study a system and concurrently to collaborate with members of the system in changing it in what is together regarded as a desirable direction. Accomplishing this twin goal requires the active collaboration of researcher and client, and thus it stresses the importance of co-learning as a primary aspect of the research process.

The research team wanted to work with a group of teachers on a capacity building programme for collaborative OER adoption, and simultaneously, study how this programme would influence the techno-social, techno-pedagogical and socio-cultural factors relating to OER adoption in the Karnataka public school system. The project involved both action (teacher capacity building on OER adoption) and research (study how the collaborative OER adoption processes would influence the school system in which these teachers worked), reflecting the dual commitment to study the system as well as collaborate with members to change it, in the area of OER adoption.
Table 4 provides an overview of research tools used, objects of analysis, and the focus of various data collection activities.

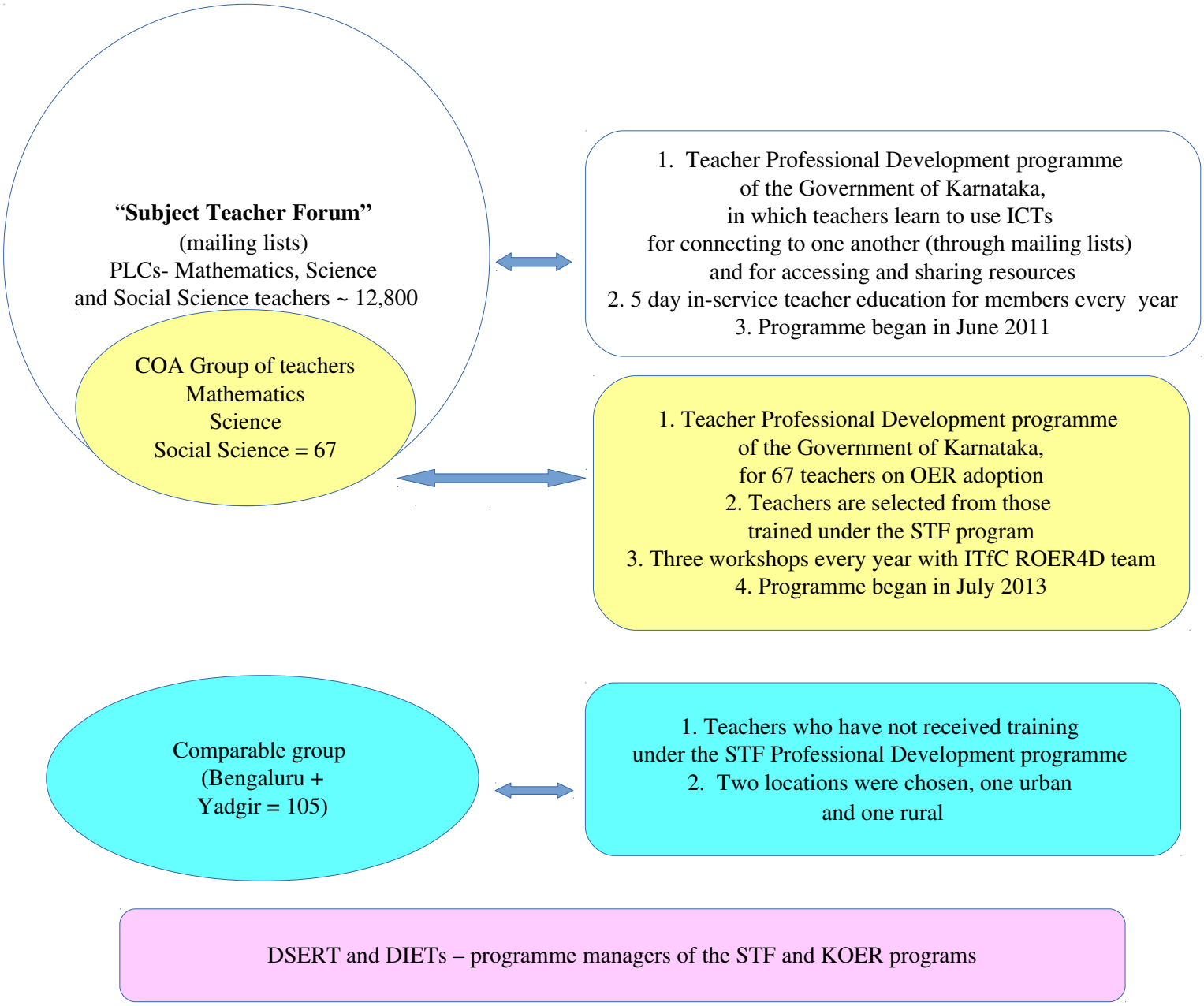
4. Table : Overview of research tools used, objects of analysis, and focus of data collection activities

Tools	**Object of analysis**	**Focus of data collection activity**
1. Structured questionnaire	67 COA teachers and Comparable group of 124 teachers	Information about ICT use, resource adoption practices, and teacher development processes
2. Focus group discussions	67 COA teachers across 10 focus group discussions	Sharing beliefs and perspectives on resources, and key concepts (OER, KOER, TPD, PLC etc.)
3. Mailing lists interactions	Mails sent and received by COA teachers on the PLC mailing lists (state-wide community of 12,800 teachers)	Reuse, creation, revision, remixing, and redistribution of resources by teachers in PLC mailing lists
4. KOER content analysis	Select content reuse, creation, revision, remixing, and redistribution by COA teachers	Creation, adaptation and sharing of resources by COA teachers on the KOER portal
5. Key informant interviews	5 Teachers, teacher educators, senior department officials	Factors enabling and constraining the development of an OER model based on COA

Figure 1 provides a graphical representation of the actors who participated in this study.

disciplinary focus.

5.1 Graphic representation of actors



(an image of the graphic representation is provided in Appendix G)

5.2 Selection of participants for the COA

The Action Research processes worked with a purposive sample of participants in the STF, who constituted the COA group. The COA group comprised teachers in government high schools. Participants were selected by the DIET based on criteria provided by DSERT:

1. participation in the PLC,
2. subject expertise and
3. basic familiarity with use of digital technologies.

A total of 67 teachers and teacher-educators were selected from different districts of Karnataka, representing diverse geographic areas of the state. The 67 teachers comprised of 26 mathematics, 18 science and 23 social science, teachers and teacher educators. Of the 67, 62 were teachers and 5 were teacher-educators.

5.3 Selection of a Comparable group of teachers

In order to determine the influence of COA processes on teachers' adoption of OER, ideally the baseline data on the COA teachers prior to their participation in the teacher education programme would have been required. There was however a challenge in doing so: while the research commenced in July 2014, the COA processes in the KOER project had commenced in July 2013. It was therefore not possible to conduct baseline research on the COA cohort of teachers.

In order to be able to understand the effectiveness of the COA processes, a set of teachers, similar to the COA group but who had not been part of the STF programme (from where the COA teachers were selected) were selected. This group was called the Comparable group. The COA group and the Comparable group were thus mutually exclusive groups at the time of the study. Since the STF programme, an ongoing teacher training programme of the DSERT was also being continued during the research time frame, it was expected that the Comparable group teachers will also eventually receive this training and be introduced to digital tools and methods. Hence, they have not been called the control group.

The selection of the teachers for the Comparable group was based on the following factors:

1. COA and Comparable groups both comprise government high school teachers from Karnataka state. The recruitment of the teachers for government schools is centralised , which means that teachers from both groups have the identical pre-requisites for recruitment and identical processes in terms of job descriptions, promotions, transfers, retirement, pay revisions, etc. Thus, the employment contexts of both groups of teachers is identical.
2. The COA teachers are from districts across the state, with rural and urban backgrounds. For the Comparable group of teachers, two districts which represented two extremes in the state (the Bengaluru Urban district and the Yadgir district) were selected. From a physical geography perspective, the Bengaluru Urban district is located in southern Karnataka and is predominantly urban (the district includes the city of Bengaluru, the capital city of the Karnataka state), while the Yadgir district is in northern Karnataka and predominantly rural.
3. Socio-economically, the Bengaluru Urban district is advanced, while the Yadgir district faces development challenges. The Human Development Index report of 2011[23] places Bengaluru Urban in first place in terms of development levels, while the Gulbarga district (which the Yadgir district was a part of at that time) is 29th out of 30 districts. The Raichur district, which is a neighbor to Yadgir, is last on the list. Both districts belong to the north-east Karnataka region, which the Human Development Report identifies as the most under-developed region in the state. It was anticipated that selecting the Bengaluru and Yadgir districts as the location for the Comparable group of teachers would provide representation in terms of the teacher contexts across the state.

Based on these factors, it is asserted that the Comparable group of teachers can serve as the 'quasi-control' group, which can provide the 'baseline' against which the influence of the COA processes on the COA group can be assessed.

23 See http://www.thehindu.com/todayspaper/karnatakaranksseventhinhumandevelopmentindex/article3034473.ece

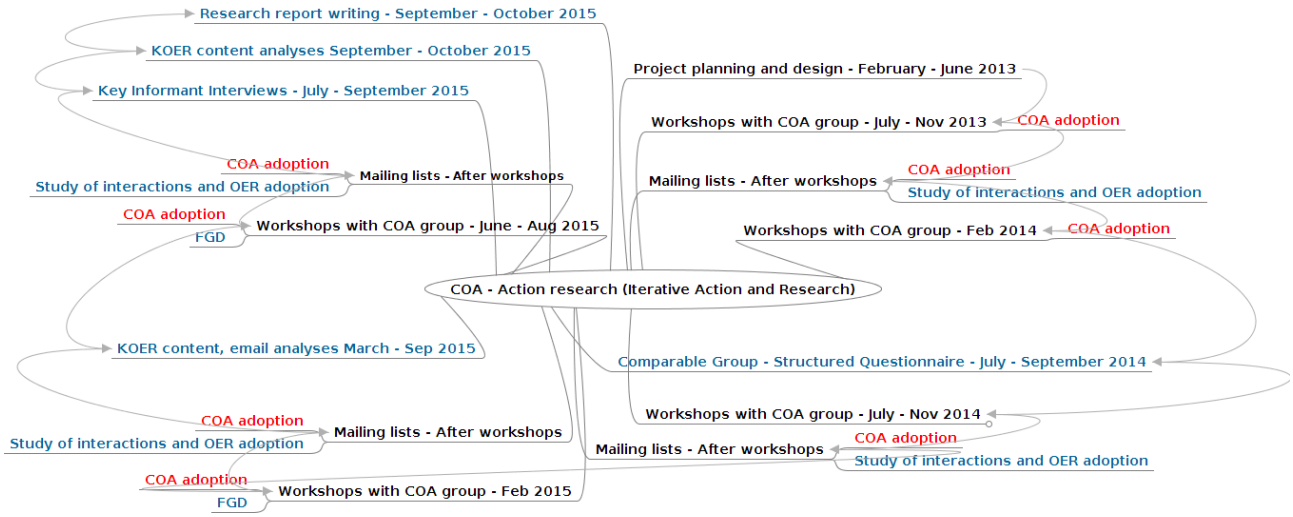
5.4 Action Research processes

The action research comprises two parts – the programmatic component of training the teachers in the tools and methods of OER adoption and the research component studying the OER adoption.

In the programmatic component, COA teachers were trained by the ITfC team on accessing, creating and sharing OER; thereafter they shared these resources via the mailing lists and uploaded resources to the KOER English and Kannada websites (created for this project under Creative Commons Attribution Share Alike Non-Commercial open licenses, on a MediaWiki platform). In these workshops, COA teachers created OER in the language of their choice, meaning that some resources were created in English, some in Kannada, and others in both languages; this OER was uploaded on the KOER website. The COA project workshops were conducted in computer labs with a 1:1 teacher computer ratio (meaning each teacher had a computer to work with), with reasonably good internet connectivity. Some teachers also brought their personal laptops to these workshops. Beyond workshops, COA teachers remained in touch with one another and the teachers in the mailing lists, in order to continue their practice of OER adoption and have discussions on different issues of academic interest.

In the research component, the COA teachers individually and collectively reflected on the COA processes in these workshops, by responding to structured questionnaires and participating in focus group discussions. While the COA processes were carried on with this selected group, these participants were also interacting with the Subject Teacher Forum PLCs to share OER. Hence, a sample of the mailing interactions on the PLC, including mails in conversation with the COA teachers were also analyzed. The OER content published on the KOER websites was analysed by the research team. As a part of the research, key informant interviews were conducted with five officials from the Education Department, to understand their perspectives on COA.

The cycles of action (workshops and mailing list interactions) and reflection (individual and collective reflections of the 67 teachers and ITfC research team), constituting the action research process, continued in an iterative manner over the two-year period of the study. A list of the nineteen workshops held with the COA teachers is provided in Appendix A.



Note: The black font indicates events, red colour font items are the programmatic processes and the blue colour font are the research processes.

The tools and processes of the research component are described below.

5.4.1 Structured questionnaire

To assess the influence of COA processes on OER adoption and TPD, a structured questionnaire was designed and administered to COA teachers as well as the Comparable group. The questions covered different dimensions like demographic and professional profile, technology habits and their use of digital resources for teaching and their own learning.

The demographic and professional profile component included questions on age, sex, educational qualifications and work experience of the teachers.

The component on use of digital methods included questions on the following:

i. Use of the computers and internet

ii. Use of ICT for their learning and for teaching

iii. Creation, sharing, accessing and adapting learning materials in their work

iv. Participation in teacher communities and forums (for peer learning and sharing)

The questions on demographic profile were designed to establish if the COA and Comparable groups were similar in their basic profile and employment contexts (using statistical tests of significance). If the profiles of the two groups were statistically found to be similar from the responses to the questionnaires by the two groups, it would be possible to make inferences, about the impact of COA processes on the digital habits, professional development including adoption of learning materials and OER as well as participation in teacher communities, of the COA group of teachers.

Printed versions of the structured questionnaire were provided to participants, who completed their responses on the questionnaire sheet. The data collection using structured questionnaire was conducted in July 2014 for the 67 COA teachers, and for the 124 Comparable group teachers in July 2014 (Bangalore Urban) and in September 2014 (Yadgir). A total of 19 responses from the Comparable group were not usable; hence the number of responses considered for this group was 105. The Comparable group responses to the questionnaire serve as a proxy baseline for the project.

The COA group of teachers also responded to the same questionnaire. Their responses would help in exploring the changes in ICT habits and OER practices as a result of their participation in the KOER project for the period from July 2013 – July 2014.

5.4.2 Focus group discussions

While the structured questionnaire attempted to identify changes in teachers' ICT habits and COA practices, ten Focus group discussions (FGD) were used to capture teachers' experiences and expectations around COA as well as their perspectives on TPD. The FGD was also used to explore the connection between the STF and the COA processes. The FGD were conducted with COA teachers in periodic workshops[24] during the 2013-14, 2014-15 and 2015-16 academic years[25].

The first focus group discussion covered ideas for designing the collaborative KOER web sites. In the subsequent focus group discussions, the discussions included the following:

24 The workshops were held separately for Mathematics, Science and Social Science teachers in order to focus on subject-specific dynamics of resource creation.

25 The school academic year in Karnataka begins in June and ends in March of the following year. April and May are summer vacation months.

i. COA teachers' experiences of the COA processes and review of the collaboratively created resources

ii. COA teachers expectations of the resource repository and methods of integrating COA with the PLC

iii. COA teachers perspectives on the role of resources and COA processes on TPD.

The key ideas that were discussed, are provided in Appendix C.

5.4.3 Mailing-list interactions

As explained earlier, the PLC was an important forum accessed and referred to by the COA teachers for an understanding of teachers' resource needs. Many COA teachers also shared their resources and experiences on the PLCs, for the re-use by, and feedback from the PLC teachers. The PLC emails were analysed on a sample basis to understand teachers' resource habits and requirements. Two mailing lists - mathssciencestf@googlegroups.com for the mathematics and science teachers and the socialsciencestf@googlegroups.com for the social science teachers – were studied for this analysis.

Both mailing-lists were 'public', meaning they are open to non-members to access as well. The members of the lists are aware of that their mails can be accessed by anyone, and also that the members of the research team (from ITfC) are members of the lists. Hence, no separate or explicit permission was taken from the teachers to analyse the mails.

5.4.4 KOER website content analysis

Resources created by COA teachers (including those shared on the PLC mailing lists by COA teachers and PLC teachers) were uploaded by them and the research team on the KOER web sites, during and after the COA workshops. Content analysis of the OER adopted by the COA group also constituted an important research component. This was done through an analysis of the KOER website.

Content analysis of KOER resources has two components: summary statistical data supplied in reports from the KOER websites (providing data on number of pages, number of files uploaded, page views, etc.), and secondly, the actual curricular content uploaded for mathematics, science and social science. For the first component – macro statistical analysis – both English and Kannada KOER web sites have been considered. For the second component – content analysis – "resource topic" pages have been analysed (each resource topic is a chapter from the grade 8, 9 or 10 mathematics and science textbooks) from the English KOER. Content analysis has consisted of identifying the different "resource units", such as concept maps, additional web links from the internet, audios, videos, images, text materials, simulations and animations that constitute the resource page.

5.4.5 Key informant interviews

In order to obtain qualitative information and perspectives relating to the aims, processes and challenges of the education department, interviews were conducted with officials from the education department. The interviews were done, using a list of probe topics, which included the following:

1. Policies and practices relating to curriculum design and material development

2. Policies, structures and practices relating to TPD

3. Use of digital learning resources and OER

5.5 Data collection and analysis

5.5.1 Structured Questionnaire

Responses to closed-ended questions were tabulated in a spreadsheet using LibreOffice Calc software application. These responses were analysed using the 'pivot' feature, which enables multivariate analysis.

The information in the multivariate tables was subjected to chi-square and two-sample z-test statistical tests of significance utilising LibreOffice Calc. Chi-square was used when data represented a chi-square distribution with two dichotomous variables, such as subject taught by teacher and membership of COA or Comparable group. In other cases, where the categorical variable was not dichotomous (e.g. work experience of teachers), the two-sample z-test was used. The size of the COA and Comparable groups is 67 and 105 teachers, respectively. As the sample size comprised of more than 30 respondents, we used sample variances as a substitute for population variances based on the assumption that in a large sample, the variances in sample and population will be similar. The z-test was selected because the sample size was larger than 30 respondents.

5.5.2 Focus group discussion

The discussions were documented as a mind map utilising the Freemind free software application. The mind map was projected during the discussions, so that participants could see the points being recorded as they were being discussed. These mind maps were shared for review. Discussions were also audio-recorded to support the analysis process. The record of the discussions (mind map and audio recordings) were analysed by research team, and grouped on the basis of pre-identified themes for discussion. Within each theme of discussion, the comments made by the teachers was recorded.

5.5.3 Mailing-list interactions

This had two parts, analyses of mail headers for all mails on the mailing-lists and a second detailed mail analyses for emails sent in select periods (3 months).

Analysis of Email headers

All emails in the Mathematics-Science and Social Science mailing lists were downloaded from mailing lists (Google groups) into the Thunderbird free software email client. Using shell scripts and Thunderbird filter features, the emails sent by COA teachers were made available separately in defined folders to enable easy access and analysis.

In order to facilitate analysis, the headers of all emails sent to the mailing lists (comprising select data elements such as sender, receiver, date-time, subject line, attachment status, word count and thread, see image below) were downloaded for all mails on the lists. Once the data was captured in a spreadsheet, email headers were analysed using the LibreOffice Calc in order to obtain summary statistics on total emails sent in a month (across all months), number of mails sent by each teacher, number of mail threads etc. The headers of all emails sent by COA teachers was identified using shell scripts, and were analysed for the study period (January 2014 – December 2015).

Detailed mail analysis

Emails of the Mathematics-Science sub-cohort of COA teachers sent in three months (August 2014, February 2015 and August 2015) were analysed. The selection of these months is based on the academic cycle – August being a "high transaction" month (after schools have opened for the academic year in June), and February being a "low transaction" month (as teachers are preoccupied with preparation for the

examinations usually held in March). Since the volume of the emails was very high, this analysis was not done for the Social Science mailing list. The following parameters were chosen for the analysis of mails:

1. Kinds of emails: This parameter indicated the nature of the email – asking for resources, sharing resources or giving feedback on a resource or simply acknowledging the receipt of a resource.

2. Subject matter of emails: This parameter captured the subject of the email conversation – school subject, educational administration, larger educational issues, larger social issues.

3. Methods of sharing: This parameter captured how teachers were sharing the resources – either as an attachment, or through web-links they have accessed or as HTML in the body of the mail.

4. Level of awareness of a resource as an OER: This parameter captured how many mails with resources, were explicitly shared as OER with mention of any open licence, or shared without any explicit mention of open licensing.

5. Format of resources / files shared: This parameter ascertained the different types and formats of resources being shared, in terms of text, image, videos, animations, etc.

Actual analysis was recorded done in a spreadsheet, by recording the analytical values for the different analysis parameters for each email, obtained from the email headers file. This analysis was done manually by studying each mail in the Thunderbird client.

5.5.4 Content from the KOER websites

In terms of data analysis, the statistical summaries automatically provided by the MediaWiki software, based on the entire site, was considered. This included the most viewed content pages on KOER, which were analysed to obtain a sense of resource popularity. This list was recorded in a tabular format using LibreOffice Calc.

The second component of data analysis, related to content analysis of the resource pages, entailed studying the Mathematics and Science resource pages in the English and Kannada websites for grades 8, 9 and 10. Each resource page was on a topic in these subjects, and contained the resources created for that topic, being concept maps, web links from the internet, audio/ video/ image files, text materials (lesson plans) and simulations/ animations. The social studies resource pages were not covered in these analyses.

5.5.5 Key informant interviews

Key informant interviews were conducted with five officials from the Education Department. Three were senior officials from DSERT, one from the Bengaluru Urban DIET and fifth was a teacher. The discussions were intentionally kept free and open-ended, to get the unfettered perspectives of the interviewees. These interviews were documented through notes taken during the process.

5.6 ROER4D network research harmonisation processes

As the overall project host, the ROER4D Network Hub conducted research harmonisation sessions for all ROER4D network members - that is, the network of close to 100 OER researchers in the Global South involved in ROER4D sub-projects. These sessions were usually conducted on-line using the Adobe Connect web-based virtual conferencing software. The objectives and agenda for each session would be shared in advance to network members in order to enable them to prepare. Usually, these meetings had a presentation on a topic relevant to the research, by an expert or a network member. The sessions were quite helpful, specifically in enabling the following features which enriched our study:

1. Shared understanding of the various terms, concepts and approaches being used in the research.

2. Comprehensiveness of the tools used by the different research projects.
3. Shared understanding of the research methods and tools utilised in other sub projects.

In line with the ROER4D approach around open research practice, SP5 also shared its research methods and understanding of concepts with the network. One particular SP5 contribution to the network was on expanding the practice of openness from materials (OER), which are the end outputs, to the methods (software applications and tools), which are the means of creating the materials. SP5 suggested the use of FOSS and applications such as LibreOffice and open formats such as .odt, .ods, avoiding the use of closed formats like .doc and .xls. The relationship between "open means" (FOSS applications) and "open ends" (OER) was also discussed in a ROER4D blog.[26]

The resources shared and discussed in these sessions were made available on a Google Drive by the ROER4D Network hub team for use by network members.

This process helped in making the research process itself more robust and aligned to the broader goals of the ROER4D project. It also strengthened the relationship between the network partners.

6 Discussion - Effectiveness of the COA process for OER adoption

The impact of the COA action research processes can be analysed in terms of the techno-social, techno-pedagogical and socio-cultural factors in the Karnataka state education system.

6.1 Influence of the COA processes on techno-social factors

The influence of the COA processes on the techno-social factors has been analysed in terms of:

1. Capacity building of COA teachers in using digital technologies
2. Creating a free and open technology environment in the public education system.
3. Systemic integration of ICTs into TPD programmes of the Education Department

6.1.1 Capacity building of COA teachers in using digital technologies

The COA processes included basic digital literacy training, introduction to access and reuse of resources from the internet, creation and remixing of resources in multiple formats and publishing on the KOER website. Training on a MediaWiki platform which allows embedding of multiple resources was an important component of the COA processes. To understand the influence of the COA processes on OER adoption and teacher development, data was collected from the COA group and the Comparable group of teachers through structured questionnaires.

It is necessary to assess if the COA group and Comparable group were similar in their demographic and professional profiles, before using the Comparable group as a proxy baseline. The next section studies the demographic profile and professional profile information, which was captured through the structured questionnaires.

6.1.1.1 Demographic profile of the teachers in the COA and Comparable groups

The demographic characteristics that were hypothesized to have a possibility of influencing ICT adoption were age, sex, educational qualifications and work experience and subject taught. If the COA and Comparable groups were found to be statistically similar in these characteristics, we could infer that the two groups are comparable. This means that any differences between the two groups with respect to use of digital technologies could be associated with the COA processes. Other demographic variables such as religion,

caste were not seen as relevant to this comparison and hence not collected as part of the structured questionnaire. The following tables describe the data along these dimensions.

Age

5. Table: Age distribution

Age (years)	Comparable	Percentage (%)	COA	Percentage (%)
Under 30	4	3.81%	3	4.48%
31–40	38	36.19%	33	49.25%
41–50	40	38.09%	27	40.29%
51 and over	19	18.09%	3	4.48%
Missing data	4	3.81%	1	1.49%
Total	**105**	**100.00%**	**67**	**100.00%**[27]

Note:

1. *As per the Two-sample Z-test, mean age is statistically similar for the two groups at 5% significance level. The computed P-value = 0.28.*
2. *In some questionnaire responses, participants had not filled the age field; this represents the missing data column. No responses were valued as 0.*
3. *As a convention, to make reading the tables easier, the values for the Comparable group are provided first and followed by the corresponding values for the COA teachers in all tables.*

Sex

6. Table: Sex distribution of teachers

Sex	Comparable	Percentage %	COA	Percentage %
Male	26	24.76%	51	76.12%
Female	79	75.24%	16	23.88%
Total	**105**	**100%**	**67**	**100%**

Simple percentages show that the sex composition of the two groups differs. The two groups are not similar by sex as the Comparable group is 75% female, the COA group is 75% male.

Professional profile

All teachers in the government school system are well qualified with a double qualification - one degree in a core subject area and a second degree in teacher education training. The qualification parameter was studied to analyse whether the Comparable group and COA group had similar levels of qualification, with educational qualifications being taken as a proxy for their investment in their professional advancement, and inclination towards acquiring additional skills.

27 The total in the table is not exactly 100%. This difference of usually 0.01% is due to rounding off during the addition of the percentages, hence not an error. This rounding off difference occurs in few other tables as well

7. Table: Comparison of professional qualifications

Highest degree obtained	Comparable	Percentage (%)	COA	Percentage (%)
Bachelors	38	36.2%	19	28.36%
Masters	48	45.72%	33	49.25%
Masters in Education	16	15.23%	15	22.39%
No response	3	2.86%	0	0%
Total	**105**	**100.00%**	**67**	**100.00%**

Note:

1. *As per Chi-square test, the distribution of teachers based on their highest qualifications in the COA and Comparable groups is statistically similar, at 5% significance level. The p-value is 0.36.*
2. *Three participants had not completed the educational qualification field; this represents the missing data column and has been excluded from the test.*

8. Table: Work experience comparison

Work experience (years)	Comparable	Percentage (%)	COA	Percentage (%)
0-5	6	5.71%	3	4.48%
6-10	27	25.71%	22	32.84%
11-15	19	18.09%	6	8.96%
16 and over	46	43.80%	31	46.27%
No response	7	6.66%	5	7.46%
Total	**105**	**100.00%**	**67**	**100.00[28]%**

Note:

1. *As per the two-sample z-test, the distribution of teachers based on mean work experience is statistically similar for the two groups at 5% significance level. The p-value is 0.51.*
2. *This suggests that both groups are similar in terms of years of experience.*
3. *In some questionnaire responses, participants had not completed this field; this represents the missing data column and has been excluded from the test.*

Subject taught

9. Table: Comparison of subjects taught

Subject taught	Comparable	Percentage (%)	COA	Percentage (%)
Mathematics	37	35.24%	26	38.81%

28 The total in the table is not exactly 100%. This difference of usually 0.01% is due to rounding off during the addition of the percentages, hence not an error. This rounding off difference occurs in few other tables as well.

Science	32	30.48%	18	26.86%
Social Science	36	34.29%	23	34.33%
Total	**105**	**100.00%**	**67**	**100.00%**

Note:

1. *As per the chi-square test, the distribution of teachers across mathematics, science and social science subjects in the COA and Comparable groups is statistically similar, at 5% significance level. The p-value is 0.85.*

Summary of results

The results above indicate that in their age, work experience, subject taught, and professional qualifications – both COA and Comparable groups are statistically similar. Any difference in ICT usage habits due to these parameters could thus be ruled out.

The COA and Comparable groups are different in terms of sexual composition. In the overall population of government school teachers in the state, there is an equal distribution of sex. As per the Secondary Education : Flash Statistics: 2014-15. DISE, the percentage shares of female teachers in Karnataka is 41.42 %. However, the COA group had 76% male teachers while the Comparable group had 75% female teachers. One factor that could have caused this difference is that the COA group were predominantly made of district-level resource persons. Selection of district resource persons tend to favor inclusion of male teachers due to actual and perceived difficulties for female teachers around issues of travel, accommodation, alternate child care, etc. Many female teachers tend to opt out of this role as this often involves additional responsibilities beyond regular teaching. Another factor could be that the Comparable group teachers were from the district headquarters (Bengaluru and Yadgir town), where more female teachers tend to be appointed.

Since the two groups were similar in four out of five parameters, it was decided to use the Comparable group as a reference, to analyse key parameters relating to use of ICTs.

6.1.1.2 ICT usage habits

The ICT usage habits captured here include duration of computer use, internet use and ownership of a computer. Since the two groups are similar in their demographic and professional profiles, any differences in ICT usage between the two groups, could be associated with the participation of the COA group of teachers in the COA project.

The data on ICT usage has been captured in three buckets to map to the programmes involved in the study. The buckets are:

i. less than one year (2013-2014)

ii. between 1 and 3 years (2011-2013)

iii. more than three years (before 2011)

The reason for this is that the STF programme has been operational since 2011 (3 years before the start of the research in July 2014) and COA teachers have been a part of the programme during 2011-2013. Participation in the STF PLC was one of the criteria for selection of the COA teachers. Therefore, the COA teachers' ICT use could be because of the COA processes (less than 1 year) or the STF programme processes (between 1 and 3 years) or before these two ICT training programmes of the education department. On the other hand, the Comparable group of teachers had not been a part of the STF and COA programmes as of the date they responded to the questionnaire, hence their digital skills are not because of the STF and KOER

programmes. Differences in ICT usage could be associated with the participation of the COA teachers in the STF (1- 3 years) and the COA (less than 1 year) programmes

Duration of use of Computers and internet

Information relating to the usage of computers and internet in the two groups was collected in the structured questionnaire. Since the COA process required the use of digital technologies, there were questions to ascertain if the COA processes had any influence on the COA group's use of computers and internet.

10.Table : Computer usage

Group	**Yes**	**Percentage**	**No**	**Percentage**
Comparable	12	11.43%	93	88.57%
COA	62	92.54%	5	7.46%

92.54% of COA teachers are using computers whereas only 11.43% of COA teachers report using computers.

11.Table : Period of computer usage

	Comparable	**COA**	**Comparable**	**COA**	**Comparable**	**COA**
Since when do you use computers	Count	Count	% of total	% of total	% of remaining	% of remaining
Less than one year	**8**	**6**	**7.62**	**8.96**	**7.92** (8*100/(105-4-0)	**54.55** (6*100/(67-44-12)
1 - 3 years	0	12	0.00	17.91		
More than 3 years	4	44	3.81	65.67		
No	93	5	88.57	7.46		
Total Result	**105**	**67**	100.00	100.00		

65.67% of COA teachers were using computers before they joined the STF program, compared to 3.81% of Comparable group teachers, which means many more teachers in the COA group were already using computers. 17.91 % of the COA group teachers began using computers between 1 and 3 years before the commencement of the COA processes as compared to 0% of Comparable group of teachers. This suggests that participation in the STF programme has a positive co-relation with the use of computers.

During the COA programme (less than 1 year), the percentage of COA teachers who began using computers is 8.96% as against 7.62% for the Comparable group. What is significant to note here is that while 26% of the teachers from the COA group, had begun using ICT either through the impact of the STF (18%) or the COA processes (8%). Furthermore, in the one year of the COA program, more than half the COA teachers who were not using computers began using computers (54.55%), compared to 7.92 % of the Comparable group. This is given in the table under the '% of remaining teachers' column – this means the number teachers who have begun using computers in the last year, as a percentage of the total number of teachers

who have not yet begun using computers, at the beginning of the year (COA programme). This suggests that use of ICT is correlated with participation in the COA processes.

12.Table : Internet usage

Group	Yes	Percentage	No	Percentage
Comparable	12	11.43%	93	88.57%
COA	61	91.04%	6	8.96%

91.04% of COA teachers are using the internet compared to 11.43% of Comparable group of teachers.

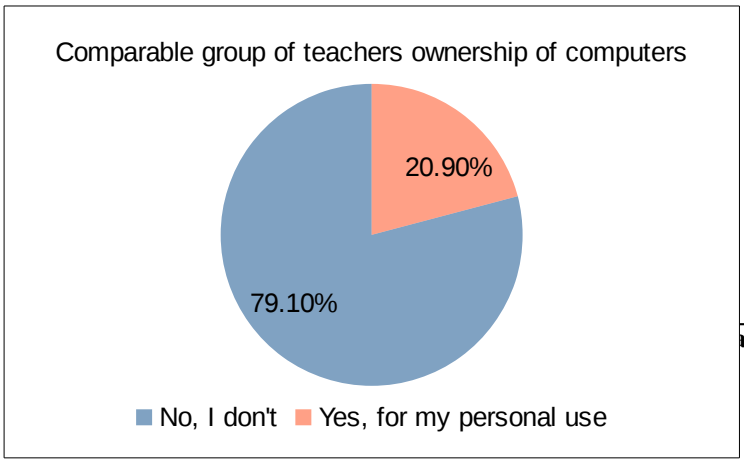
13.Table : Period of internet usage

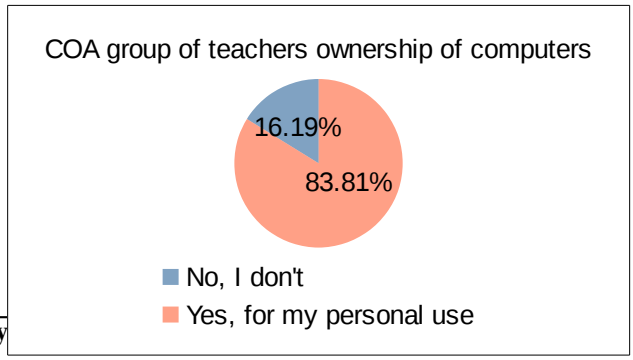
	Comparable	COA	Comparable	COA	Comparable	COA
Since when do you use the internet	Count	Count	% of total	% of total	% of remaining	% of remaining
Less than one year	8	7	7.62	10.45	**7.92**	**53.85**
1-3 years	1	9	0.95	13.43		
More than 3 years	3	45	2.86	67.16		
No	93	6	88.57	8.96		
Total Result	**105**	**67**	100.00	100.00		

The COA group began with a higher internet use than the Comparable group (67.16 % and 2.86%); yet the increase in the number of teachers during the previous three years (which covers the period of the STF program) is higher than that of the Comparable group in the use of internet (13.431% and 0.95 %). As in the case of computer usage, about 24% of the COA teachers began using the internet either through the impact of the STF (13.43%) or the COA processes (10.45%). In the one year of the COA program, more than half the teachers who were not using internet began using internet (53.85%), compared to less than 7.92% of the Comparable group. The above tables suggest that participation in the COA processes have a positive co-relation with the use of computers and use of internet.

Computer ownership

The ownership of a personal digital device can indicate that digital technologies are seen to be of value. In this sense, ownership of a laptop by a teacher suggests that the teacher sees value in using computers.





The graphs ascertain if the COA processes had an influence on the COA teachers, regarding value proposition of a computer, by studying how many of them own a computer. 83.81% of COA teachers own their own laptops or desktop computers, while 20.9% of Comparable group do.

The COA programme encouraged teachers to purchase personal laptops and internet connectivity, providing specific inputs on various options available and cost-feature comparisons. While the mobile phone was seen as a personal necessity by all teachers (due to compelling benefits of being able to support voice communication across space and SMS communication across space and time), this initially was not the case with computers or the internet.

During the COA programme, COA teachers were seeing the value of regularly using computers and the internet. This persuaded them to purchase these devices and connectivity for personal use. Purchase of their own devices can be seen as a powerful proxy for their self-belief in their capability to use ICTs.

A number of technical issues faced by teachers were resolved by conversations on the mailing lists and by referring to the "Frequently asked questions" on the KOER website, which provided solutions to commonly encountered technical problems. This page on the website is consistently amongst the top ten most viewed pages on KOER (see Appendix E), suggesting that teachers' are open to exploring solutions to doubts or challenges faced by them during use of ICTs.
The tables provided above from the data collected through the 'structured questionnaire' indicate that the COA teachers are similar in age, work experience, educational qualification and subjects taught, to the Comparable group of teachers. However, the tables in this section indicate that the COA teachers use computers and the internet to a much greater extent, compared to the Comparable group of teachers.

6.1.2 Free and open technology environment

The COA teachers were trained in a variety of FOSS applications and platforms in the workshops, and the agenda had a conscious emphasis on FOSS, both in terms of the theoretical implications (philosophical, pedagogical, technological and economic aspects) and practice (learning to work with FOSS applications). The use of FOSS was embedded within the COA processes based on the idea that if resources are to be adopted freely, the tools for adopting the resources should also be freely accessible. Free and open source software has its parallels to the 4Rs in terms of freedom to use, freedom to copy, freedom to modify and freedom to redistribute. The research team referred to the notion of FOSS as "public" software, the word suggesting that it was owned by all, and hence open to use by all. COA teachers related to the "public" term ("*sarvajanika*" was the Kannada word used by the research team) in that they belonged to a "public" education system (*sarvajanika shikshana ilakhe*), open to all students without barriers; the schools in which they worked were called "public schools" (*sarvajanika shaale*). Many of them made the connection of needing "public software" for a "public education system".

The research team prepared a custom distribution of the Ubuntu operating system called "Kalpavriksha", into which more than 3,000 free and open source software packages, including the educational software applications taught to COA teachers, were bundled.

COA teachers had to pay a nominal amount (less than USD 2) for a copy of this custom distribution , this amount was collected to cover the costs of producing the custom DVD. The intention was to help the COA teachers discriminate between the use of the word free as in "freedom" (to copy and reuse) rather than

"gratis" (free of cost). COA teachers purchased the DVD willingly and some reported back that they had redistributed this to their colleagues (outside of the COA group). The custom distribution reduced installation time and effort, since all software applications bundled in the custom distribution were installed automatically along with the Ubuntu operating system. Proprietary operating systems will not allow such "free sharing" or "bundling". Appendix F provides a brief description of the FOSS applications that teachers were exposed to in the COA workshops.

6.1.2.1 Change in teachers' conception of resources

This emphasis on the use of FOSS tools and processes enabled movement from the commonly used Power Point presentations to many other options. In a case study that he carried out on STF-KOER, as a part of a Wawasan Open University project, Rajaram Sharma (Vignettes of Selected Asian Experience. WOU Press. 2016. Edited by G. Dhanarajan, page 65) states:

> The exposure to the free and open source software applications has introduced teachers to a variety of resource formats, enabling their movement from the common "power point presentations" to mind maps (using Freemind), interactive simulations (using Geogebra), text and presentations (using Libre Office), web links and video files (using RecordmyDesktop). They are also seeking and exploring multiple tools that can work on different devices and looking for convergent solutions - mobile upload of a solution to a solved problem (solved by hand), sharing recordings of broadcasts by teachers, looking for mathematical teaching learning software for the smart phone, exploring Unicode font converters for local language typing or upgrading Geogebra from its 2D version to a 3D one.

In the typical, constrained environment of proprietary software, (usually manifest in a personal computer with the Microsoft Windows operating system, Microsoft Office suite, internet Explorer/ Edge and Adobe Acrobat PDF reader), the user is typically forced to limit his or her imagination to the functionalities of these applications ("What is it that I can do with the tools I have?"). In a FOSS environment, teachers often approach the issue from the perspective of "What is it that I want to do, and what tool will I need for this task?" and search for the tool either in the Ubuntu software centre repository on their desktop or on the internet.

The analysis of the PLC interactions on the mailing lists revealed that teachers shared useful tools that they discovered with their peers on the virtual forums. COA teachers also identified equivalent free tools in the mobile environment, which they were using in the desktop environment (such as free dictionaries, Geogebra, and text editors) and shared these on mailing lists.

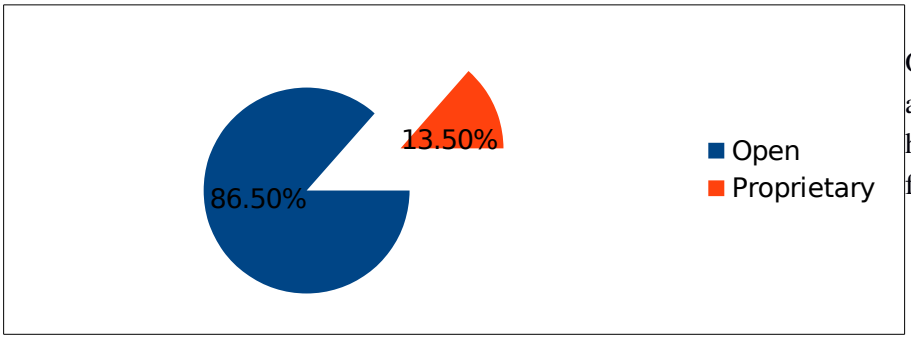
The ability to use multiple tools to create resources in multiple formats is evidenced in the table 14, which lists the number of resources shared on the mailing lists by COA teachers, by the format of the files.

14.Table: File formats of shared content

File type	Format (file extension)	Comments	Number	Open or proprietary
Image	Jpg		23	Open
Image	png		1	Open
Video	flv		2	Proprietary
Geogebra	ggb		30	Open
Text	eml	Mail	24	Open
Text	odt	Editable Text	18	Open

Text	pdf	Non editable text	42	Open
Text	html	Web page	13	Open
Text	docx, doc	Editable text (proprietary)	8	Proprietary
Text	xls, xlsx	Spread sheet	7	Proprietary
Text	pmd		1	Proprietary
Text	ppt, pptx	Slide presentation	4	Proprietary
Total				

A graphical summary of the table is presented below:



Of the total file formats shared, around 86% of the resources have been shared in open formats.

Resources being required to be free and open,[29]

In focus group discussions, COA teachers articulated an expectation that resources must be freely available (i.e. at no or low cost) and open to revision for use in the classroom. Teachers recognised that digital formats had several advantages. Diversity of resources to address multiple contexts, accessibility, adaptability, and versatility to meet multiple purposes were seen as enriching and essential.

6.1.3 Systemic integration of ICTs into TPD and OER adoption

6.1.3.1 Systemic availability of ICT infrastructure for teacher training

The tools and methods for creating OER are primarily digital and OER adoption will be affected by the extent to which digital infrastructure and support are available in a particular environment. The COA programme made design choices that emphasized digital processes. COA workshops were conducted in computer labs where the programme required teachers to have a 1:1 access to computers with reasonably good internet connectivity. Teachers were required to become familiar with multiple resource creation methods, using different software applications, and learning to publish OER on a MediaWiki platform.

Resource materials were also shared on the KOER website for participants to access; print versions were usually not given to the participants (whereas in typical teacher training workshops, each participant would be handed a print copy of the training module at the start of training). Workshop feedback was also compiled digitally and shared with the DSERT. This emphasis on the use of the digital for the design, implementation and reporting of the training programme made the systemic availability of ICTs a prerequisite, thus altering the way teacher education was imagined. The programme required the

29 Educational resources in general and on the internet

maintenance of the digital infrastructure in the ICT labs, this was taken care of by the DIETs, thus institutionalizing technology integration at district level.

6.1.3.2 Perspectives on technology and teacher training

The key informant interview discussions covered the experiences and insights of officials in regard to the core ideas of the programme, including integration of digital technologies in an in-service TPD program, use of digital technologies for OER adoption, use of FOSS instead of proprietary software applications etc. These are summarized below.

1. Department officials appreciated the benefits of using free and open source tools. They appreciated the value of teachers receiving a single DVD containing a custom distribution ("Kalpavriksha") of the FOSS operating system bundled with all the software applications required

2. DIET faculty, by and large, saw the integration of digital technologies in the programme as an important requirement for school education and were supportive. Many DIETs made special efforts to improve the ICT labs in their institutions, replacing dysfunctional hardware, boosting network connectivity, etc. Some DIETs also identified ICT labs in other institutions (higher education institutions like engineering colleges, teacher training colleges, etc.) to increase their access to ICT infrastructure to allow more teachers in the districts to be trained in the STF programme, thereby growing the PLC.

Role of teacher training in effective ICT adoption

In a key informant interview, the DSERT officer in charge of the programme used an analogy to explain the importance of teacher development in the systemic integration of technology. In earlier ICT programmes, the Department focused on providing ICT infrastructure to schools without adequately building teacher capacity to use the infrastructure for their teaching activities. That approach did not work and teachers largely did not use the infrastructure. When the STF programme and the COA programme focused on training teachers to use ICTs, many teachers purchased personal computers, seeing the relevance and benefit of ICTs for their professional development. The officer made the analogy that the Department had earlier provided bicycles (meaning computers) to schools, but did not teach cycling and therefore nobody learned how to cycle. Teachers were now being taught how to cycle (how to use computers and the internet) and many were purchasing their own bicycles (computers). He suggested that, while both infrastructure provision and capacity building were both required to enable the use of a technology, capacity building was critical to use of ICT by teachers, suggesting a change in the way teacher training and ICT implementation in schools could be imagined.

6.1.4 Techno-social challenges

Though the COA did influence the techno-social factors as discussed above, teachers articulated several challenges and constraints, in their interactions with the research team and on the mailing lists. These are summarized below.

1. The KOER project required teachers to be trained in the use of tools for OER access, creation and publishing on an on-line website. Though the Education Department had provided labs, ICT infrastructure still had limitations in that the number of computers in ICT labs was sometimes insufficient. Internet connectivity was patchy and some computers were dysfunctional. These limited the ICT availability for COA processes.
2. The OER adoption process was through the use of an on-line resource website based on the MediaWiki platform and required teachers to become proficient in the use of multiple applications, visualize web

based organization of resources, alongside the pedagogic competencies required for revision of resources.

3. COA teachers opined in the focus group discussions that the process of learning how to use ICTs (digital methods) was complex and layered. Even if basic digital literacy was acquired, becoming proficient required devoting significant time for practice, which was seldom available.
4. A further challenge was in terms of internet connectivity which was difficult in many areas, specially areas that were far away from towns. Quality of the connectivity was quite poor, and bandwidth was inadequate in their schools and at their homes. On-line resource creation processes were difficult to do. Power outages were quite common in many areas, which made using desktop computers difficult. COA teachers spoke of their difficulties in using computers and finding materials on-line. Internet was not available in schools and most parts of the state still only had 2G[30] internet. While the Education Department provided ICT infrastructure for the COA workshops, continuous resource creation and adoption was impacted by these constraints.
5. In addition to the ICT availability challenges, imagining resources in an on-line format required pedagogic competencies as well as technology comfort. The COA teachers shared that they found direct editing of content on the Wiki portal difficult and intimidating and suggested that the COA processes should explore methods of publishing the OER shared on the PLC mailing lists. The idea of distributed, bottom-up resource creation utilising the on-line KOER Wiki appealed to COA teachers, but the previously mentioned limitations impacted upon the realisation of this ambition.
6. Some teachers brought with them a legacy understanding of ICTs as a set of proprietary tools to be used for very specific purposes, and it took time to move to a perspective of ICTs as a set of processes that could alter current content and pedagogical approaches. While discussions on the mailing lists about using public applications suggest that FOSS has been accepted by teachers, proprietary applications and proprietary document formats are still being used, though this is not the default anymore.

6.2 Impact of the COA programme on techno-pedagogical factors

The impact of COA on techno-pedagogical factors has been studied in terms of the following:

1. Influence of COA processes on OER adoption
2. Impact of COA processes on TPD

6.2.1 COA processes influence on OER adoption

6.2.1.1 OER adoption processes

In the structured questionnaire, the COA and Comparable group teachers were asked about their resource creation, sharing and adaptation practices. The COA teachers reported higher percentage of material creation (88% as against 59% for the Comparable group) and material sharing (97% as against 65% for the Comparable group). While the COA teachers were chosen based on their participation in the STF programme and were already resource persons for the education department, it is seen that this high percentage of resource creation and sharing is correlated with their participation in the COA processes.

15.Table : Creating and sharing OER

Group	Creating learning materials	Percentage	Sharing learning materials	Percentage

30 The term "2G" refers to second-generation internet, which has lower bandwidth than third-generation internet.

Comparable	62	59.05%	68	64.76%
COA	59	88.06%	65	97.01%

Responses to the structured questionnaire indicate that COA teachers had far greater engagement with resource adoption than the Comparable group of teachers. Table 16 seeks to ascertain if the COA teachers resource practices, in terms of their adapting OER is more than Comparable group of teachers

16.Table: Adaptation of learning materials

Learning materials adaptation	**Comparable** group	**Percentage**	**COA** group	**Percentage**
Use with own examples	70	66.67%	66	98.50%
Reduce/add content	65	61.90%	61	91.04%
Mix two or more materials	52	49.52%	58	86.57%
Change format (document layout)	55	52.38%	52	77.61%
Change sequence	58	55.24%	52	77.61%
Translate to another language	45	42.86%	50	74.63%
Use for a different purpose from original purpose	43	40.95%	39	58.21%

Note 1. The percentages in this table are all individually computed on a base of the total number of teachers in the respective groups. They do therefore not add up to 100% across the rows

There are different levels of reuse and adaptation of OER. Okada (2010) identifies 12 levels of reuse of OER. The COA teachers have reported significantly higher percentages of resource adaptation habits across different levels of OER reuse. This suggests that the COA processes had an impact on the teachers' OER adoption habits.

The table is shown as a graph below, this sorted on the order of adaptation practice by COA teachers

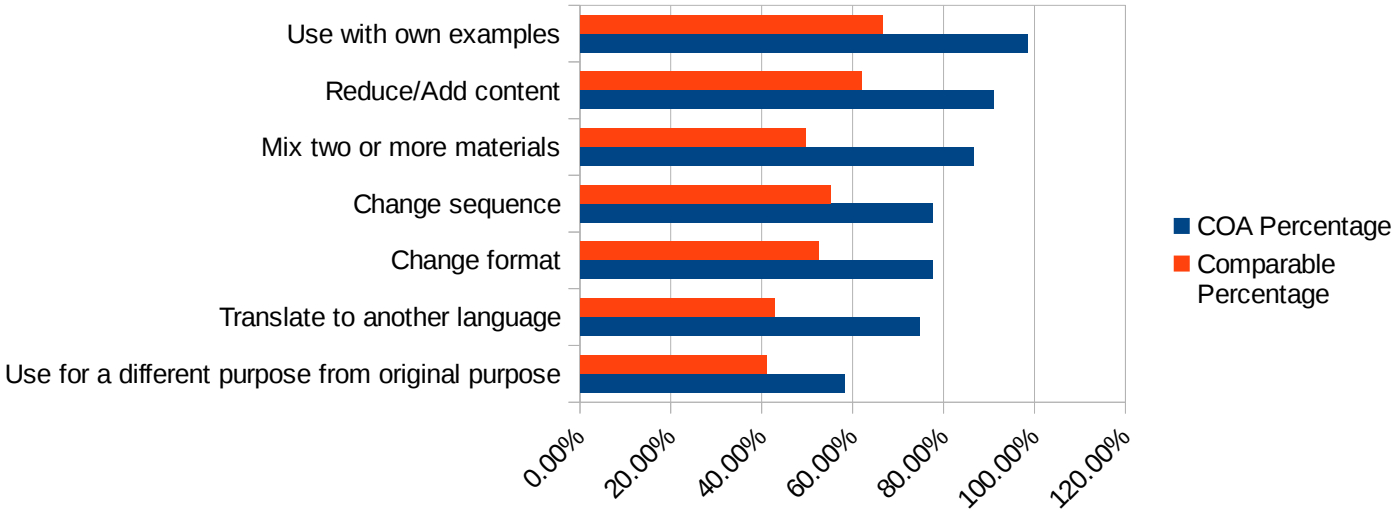


Figure: Learning materials adaptation activity

The level of learning-materials adaptation activity indicates an ability to engage in the resource adaptation processes. COA teachers not only show higher rates of content adaptation, but also higher level of use of sophisticated adaptation methods, such as use of materials for a different purpose from the originally intended purpose and remixing two or more materials. The Comparable group teachers also adapted learning materials to meet their needs; however, the rates of adaptation appeared lesser.

While the textbooks provided to teachers by the DSERT are in text format, teachers recognised, in the focus group discussions, that a wider variety of resources was available to them for use in the classroom. COA teachers felt that digital technologies allowed easy sharing of OER.

6.2.1.2 Design of the KOER website and OER creation

The OER platform (KOER website) was designed in consultation with the teachers in terms of form, structure and content. The choice of the MediaWiki platform was an important pedagogic decision as it offered the possibility of a bottom-up OER creation platform as opposed to an expert driven traditional resource creation model, often used in the Education Department. The advantages of the platform allowing remixing of different kind of OER were also discussed by the COA teachers.

The OER development was conceptualized in a modular way with topics for resource creation being allocated to teams of teachers. Each topic was developed as a resource page. The template for a resource page was developed in consultation with the teachers and refined over the COA programme to allow for individual resource units to be shared by different teachers. The resource template had sections for content, as well as for activities and processes, thus allowing for an integrated approach to technology, content and pedagogy. The COA teachers appreciated that the template allowed them and other teachers to navigate across different topics in KOER by providing a similar interface. The COA teachers also suggested an on-line form be developed for content submissions, by the PLC teachers, which could be added to the KOER website. that an on-line form be developed for content submissions.

6.2.1.3 OER processes seen on the KOER website

The MediaWiki platform enabled teachers to contribute (create), edit (revise), and combine (remix), resource units[31] on any page. COA teachers created resource units in the form of text materials, images, audio clips, videos resources, concept maps, and Geogebra simulations[32]. A review of the KOER pages pertaining to the resource topics (forming chapters in the grade 8, 9 and 10 textbooks for mathematics and science subjects[33]) on the KOER website is described in Table 34, listing the resource units, which are the resources with lesson plans, concept maps, audio-visual resources, classroom activities, and assessment activities.

Table 17 indicates that teachers are remixing a variety of text, image and audio-visual resources for each topic on the KOER resource topic page.

17.Table: KOER content by type of resource available

Subject	**Number of resource pages created**	**Concept maps**	**Additional web links from the internet**	**Audio/ video/ image files**	**Text materials (lesson plans)**	**Simulations/ animations**
Mathematics (English)	39	24	22	18	23	8
Science (English)	56	21	25	23	16	4
Mathematics (Kannada)	42	9	7	6	5	2

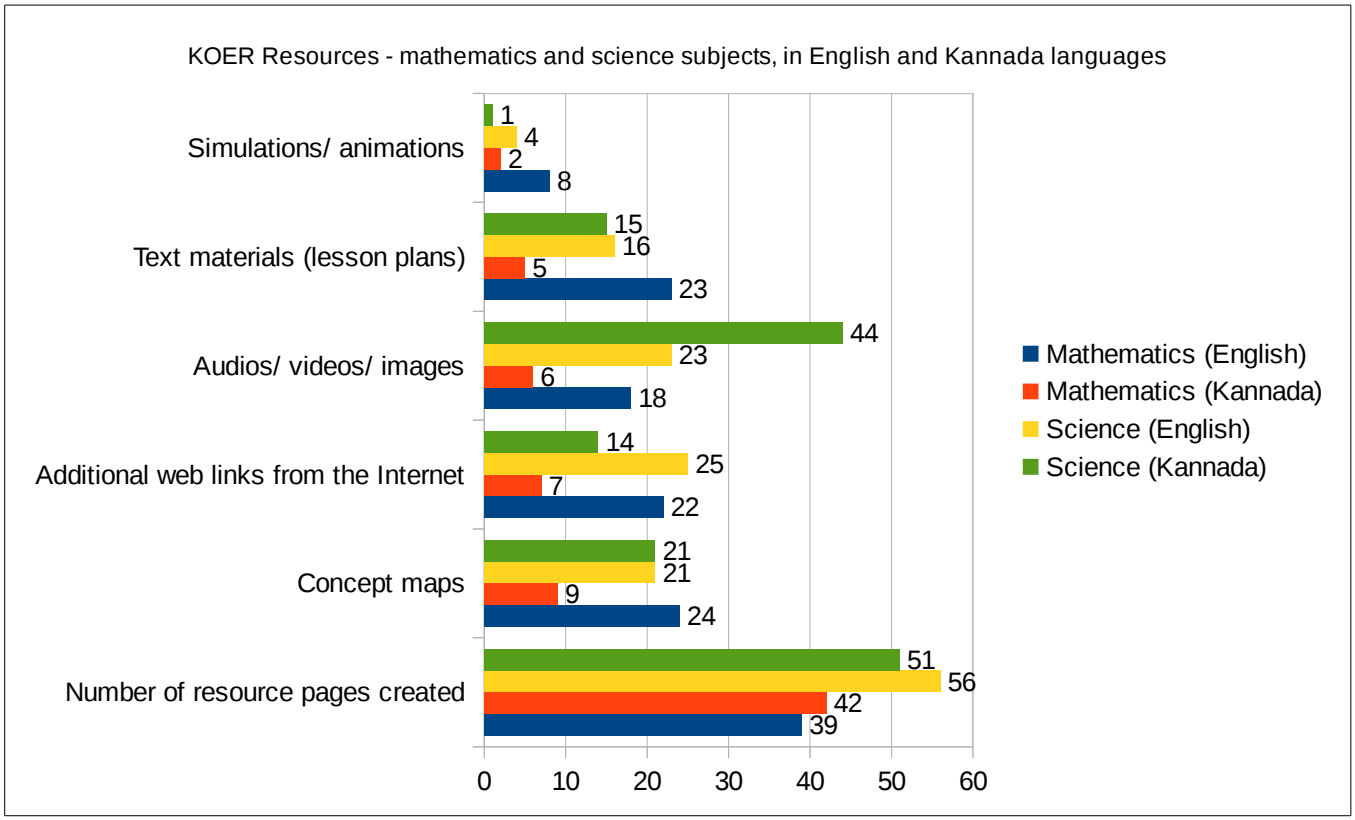
31 Resource units consist of text, images, audio, video resources and any combinations of these.

32 See, for example, the pages on circles: http://karnatakaeducation.org.in/KOER/en/index.php/Circles

33 Social science content was not analysed in this manner.

Science (Kannada)	51	21	14	44	15	1

The table is graphically illustrated below:



6.2.1.4 COA teachers' review of the OER platform and COA processes

During the focus group discussions, teachers reviewed the KOER resource repository both in terms of content created and the processes of its adoption. The suggestions that emerged from these discussions are outlined below.

1) The teachers suggested specific changes in terms of the form and content of the repository to make it more accessible to teachers. Teachers felt that it would be useful to categorize resources in terms of intended use (e.g.,videos of experiment demonstrations, solutions to difficult problems, etc.) to allow for easier user navigation. They also felt that the KOER website should make accessible existing curricular resources created by the Education Department (textbook supplements, teacher handbooks for assessments, etc.).

2) The teachers indicated that there is a need to build awareness amongst teachers and orient members of the state education department about the OER website. Using the STF PLC mailing list, sharing though mobile (WhatsApp) communities and sharing through articles and newsletters from the Education Department were suggested as possible methods of popularising the KOER website.

3) For sustained OER creation, the COA teachers suggested a decentralized model, comprising district-level resource groups which could contribute to KOER regularly, anchored by the DIETs in each district. They also suggested increasing the core group of resource creators through the decentralized district-level groups. The teachers further emphasized that in order to allow teachers to continue this OER process in a sustainable way, it was important for the Education Department to make resource creation as a formal responsibility of teachers, and to incorporate a mechanism for reviewing the quality of resources.

6.2.1.5 PLC as a site for OER adoption

COA teachers envisaged the mailing list as a way to pool resources which could be organized and uploaded on the KOER website. The PLC provides the context for resource creation by articulating resource needs and providing a forum for sharing the resources created. COA teachers saw the PLC as a significant contributor to their thinking on resource-creation. In addition to sustaining OER creation, the teachers felt that adopting the resources shared on the mailing lists would encourage critical thinking in teachers and enhance TPD.

An analysis of the mails on the PLC provided information on the kinds of mails, subject matter of discussion, and different file formats of resources. For these tables, the mails sent on the mathematics and science PLC list for the three months of August 2014, February 2015 and August 2015 are considered.

18.Table: Number of emails by COA processes

Row	**COA processes**	**Number**	**Percentage**	**Percentage**
A	Sharing resources – accessed	56	34.43%	
B	Sharing resources – created	102	62.58%	
C	Sharing resources – revised	3	1.84%	
D	Sharing resources – remixed	2	1.23%	
E	Total – resources shared	163	100.00%	34.5%
F	Other mails (where no resources were shared)	296		64.5%
G	Grand total of mails	459		100.00%

The number of emails containing resources created by teachers (102) is higher than the number sharing resources accessed elsewhere (56). This suggests teachers are open to sharing the resources they have created. The lower number for resources accessed can also be due to limitations in internet search habits amongst teachers and a paucity of resources in the Kannada language.

Since the PLC mailing list was an open forum for teachers, it was used for sharing resources as well as for discussion on various topics of interest. Most of the "Other" 275 emails focused on discussions about different topics.

6.2.2 Impact of COA processes on TPD

6.2.2.1 OER as a counter to the textbook culture

Development of curricular resources is seen as an important aspect of TPD[34]. The research attempted to examine if OER adoption could provide the teacher with additional learning materials to counter the "textbook culture". The table, using data collected from the structured questionnaire illustrates the COA and Comparable group of teachers' use of additional materials other than the textbooks and teacher guides provided by the education department.

19. Table: Use of learning materials other than textbooks

Use of additional learning material?	Comparable	Percentage	COA	Percentage

34 National Council of Teacher Education. (2010). National Curricular Framework for Teacher Education. Retrieved from http://ncte-india.org/ncte_new/pdf/NCFTE_2010.pdf

Yes	76	72.38%	62	92.54%

The table compares the COA and Comparable group of teachers' use of additional materials other than the official textbooks and teacher guides. The table suggests that the percentage of COA teachers who reported using additional learning materials (other than the text book) (92.54%) is higher than the Comparable group (72,38%).

The questionnaire further collected data on the frequency of use of additional learning materials and the data is summarized below. The figure below is to ascertain if the COA teachers used learning materials, other than the textbook more than the Comparable group.

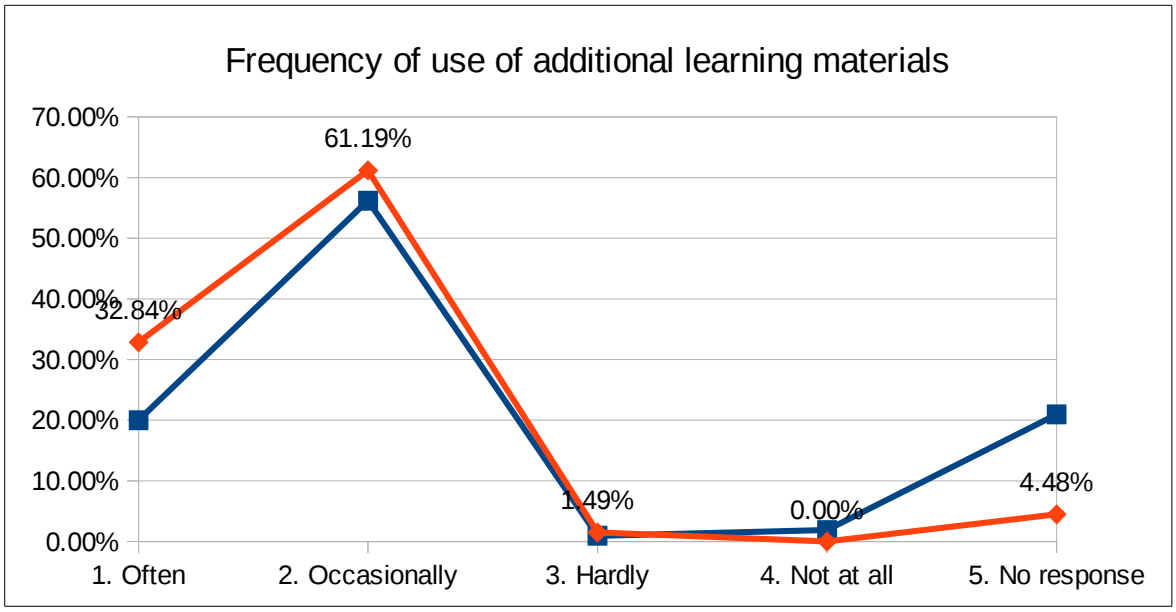


Figure 3: Frequency of teachers' use of additional materials

(red – COA and blue - Comparable)

The COA teachers reported higher percentage of more frequent use of learning materials (32.84% of the COA teachers reported that they often use learning materials as against 20% for the Comparable group). The extent of occasional use of learning materials is also slightly higher among COA teachers (61.19%) than among the Comparable group (56.19%), indicating a very similar pattern of using materials other than the official textbook or teachers' guides.

The use of ancillary materials in addition to those traditionally prescribed by schools is an indicator of teachers' engagement with their profession and self-development. A higher percentage of additional resource use among COA teachers, many of who are district and state level resource persons, suggests that engagement with curricular resources is correlated with TPD, considering their trajectory of development from a teacher to a resource person and trainer Further, during the focus group discussions, COA teachers questioned the dominant role that the textbook historically played in their teaching and felt that looking at a variety of resources helped them in their own learning. They articulated the elements of TPD they considered important and were able to map COA processes on TPD in terms of impact upon their practice, development of new skills, and teacher identity. Teachers could make the connection between COA processes and TPD aspects and were able to articulate their own trajectories of development as well as aspirations.

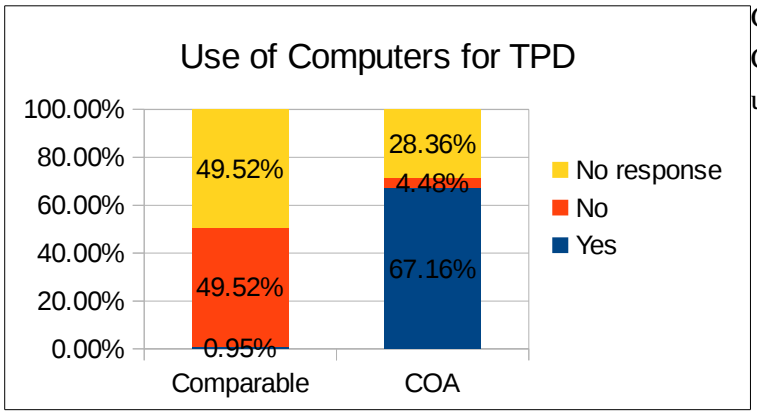
In the focus group discussions, COA teachers expressed that resources that supplement the text book can help to increase their content knowledge, and increase student interest in a subject. They articulated advantages for using resources to make teaching and learning more effective in terms of time, quality of transaction, general conceptual clarity, and more engaging learning experiences. Resources in general, also played a role in increasing creativity of teachers, by allowing thinking about various options and possibilities in teaching.

The COA teachers felt that the COA processes were valuable in terms of updating their knowledge. They spoke of the development of new skills in terms of reading, writing, review, feedback, considering multiple perspectives, research capabilities, interacting with other teachers, and supporting and training fellow teachers. They spoke about their identity as teachers/resource creators, their capabilities as resource persons for training other teachers, self-awareness of professional development needs, possibilities for creativity and self-expression, and an increased sense of agency as they interact with school administration and gain greater confidence in themselves.

6.2.2.2 Impact of ICT on Teacher Professional Development

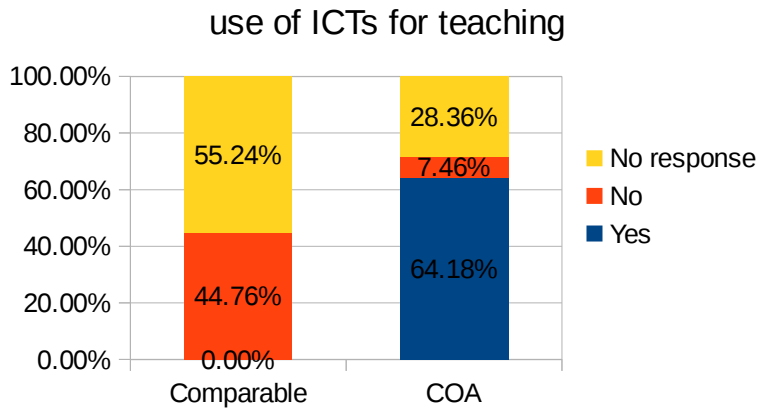
With digital methods being centrally involved in OER adoption, an important question for the research was to investigate how enhancing abilities in use of ICTs could impact TPD. The questionnaires administered to the COA and Comparable groups captured information on their ICT use for their learning and use in teaching

Use of computers and internet for fulfilling development needs



Graphic compares the COA and Comparable group of teachers' computer use for their own professional development.

Impact of COA on Teachers' teaching



An important measure of teacher development is in terms of the impact on their teaching practices. The figure below captures the use of ICT for teaching, vis a vis the Comparable group of teachers.

There is a difference between the two groups in their use of ICTs to prepare for teaching and for teaching. Comparable group teachers reported

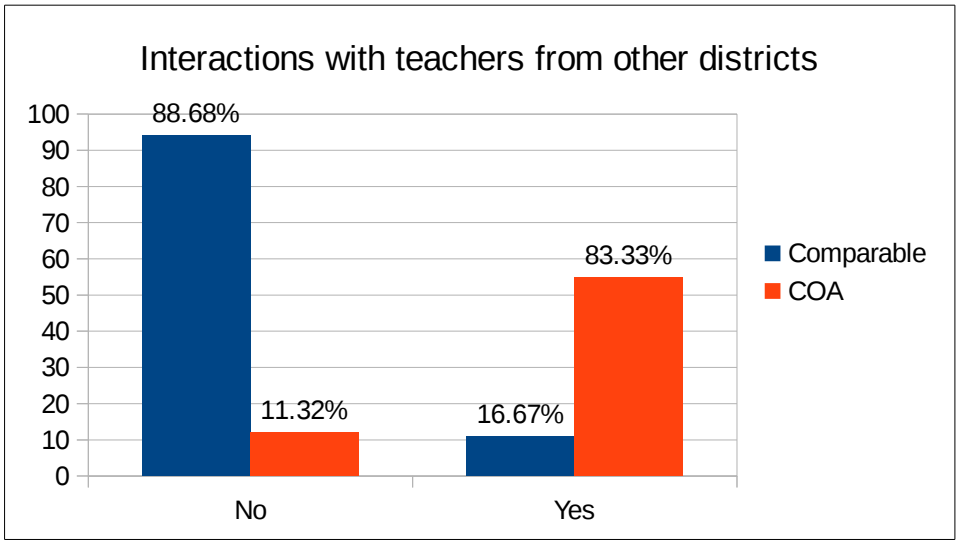
zero use of ICTs in their preparation and teaching practice; while COA reported a 62.69% and 64.18% use of ICTs for preparation and teaching, respectively.

> Teachers' use of ICT in different ways
>
> In the focus group discussions, COA teachers shared that they actively documented classroom processes (such as field visits, lab work, specimens collected, and places visited) and shared these through the PLC for publication on the resource repository. This documentation was done by them in their schools and constituted a significant shift in the way teachers viewed resources. For instance, one mathematics teachers had recorded a lesson using Google Maps on a desktop recording tool to supplement a lesson in a mathematics class on mapping and measurements. Social Science teachers prepared and shared videos of enactments of skits of historical events by their students.

6.2.2.3 Impact of COA processes on teacher networking

The research examined how conversations around OER adoption can become an effective method of Teacher Development, by addressing teacher isolation. The structured questionnaire captured data on the extent of professional interactions within teachers across different contexts; the objective was to see how ICT enabled COA processes could impact possibilities for networking and peer learning. Mails on the STF PLC were also analysed to understand the nature of conversations around OER adoption.

The interactions of COA teachers with teachers at all levels (school, taluka, district and state) is much higher than the Comparable group teachers. This can partly be attributed to the STF program, in which teachers learnt how to participate in virtual forums (mailing lists). As per the graph, COA teachers are in active contact with peers at block and district levels, as well as beyond their districts. While only around one in nine teachers in the Comparable group had contact of this kind with fellow teachers, more than four out of five COA teachers maintained such contact.



Collaborating to create resources

Along with networking with other teachers, it was sought to be ascertained if the COA teachers collaborated with other teachers for resource creation. Two questions were asked – on collaborating to create resources and willingness to accept revision and modification in resources created. The tables below describe the results.

20.Table: Creating resources in collaboration with others

Comparable	Percentage	COA	Percentage
6	5.71%	50	74.63%

75% of COA teachers create resources in collaboration with others in contrast to 5% for the Comparable group. This shows that COA processes have supported teacher collaboration for OER creation.

21.Table: Changes made to resources created

Response	**Comparable**	**Percentage**	**COA**	**Percentage**
Yes	8	7.62%	54	80.59%
No	15	14.28%	6	8.96%
No response	82	78.09%	7	10.45%

81% of COA teachers reported that they welcomed other teachers making changes to their resources; a marked difference to only 7.62% of teachers from the Comparable group.

There seems to be a association between the COA programme and the teachers' willingness to collaborate on OER adoption.

6.2.2.4 PLC as a source for OER and peer learning

The mailing lists of the PLC were analysed to understand the nature of conversations among the teachers – the COA group and the larger STF community.

22.Table: Thread count analysis of mails

Thread count	**Number of mails in the thread**
1	2,020
2	1,995
3	989
4	554
5	272
6	224
7	104
8	84
9	88
10	74
11	21
12	33
13	37
14	13

15	15
18	17
19	18
20	19
21	60
22	22
25	24
Total Result	6,683

In total, 2,020 mails (around 30%) have a thread count of 1, meaning they did not get any response. Conversely, 70 % of emails were part of a thread (a conversation). This suggests a high level of interaction amongst teachers; emails with a thread count of five or higher, represent 13% of the total emails. Thus, over two-thirds of the emails constitute conversations, and less than one-third of the mails are single posts.

In addition, apart from the sharing of resources, the mailing lists have seen discussions on a range of issues and concerns, from subject teaching to larger school and education-level issues to wider socio-political issues. These discussions have themselves been a source of learning and broadening of teacher perspectives, and can, in a sense, be seen as educational resources in themselves. The mailing lists have emerged as spaces where teachers were taking ownership of their own learning and development, self-regulating their conversations, and moderating interactions. The mailing groups operated as "always available" spaces for teachers to raise issues they considered important. This can be seen in the light of Gidden's assertion that "mediated contacts that permit some of the intimacies of co-presence are made possible in the modern era by electronic communication" (1984, p. 68).

The agenda for discussions in the lists is decided by the teachers, through their posts. These forums do not have any official regulation, and teachers' self-regulation suggests that teachers do feel a sense of agency when they participate in these forums. Some examples of such conversations include the status of teachers in the school system and in society, resignation of the Director of the National Council for Education Research and Training[35] (NCERT), and constitutional provisions for the socio-economically backward north-eastern region of Karnataka. In another thread, the depiction of teachers in Indian mass media came under strong criticism for being uninformed and driven by sensationalism.

Teachers commented on their relative powerlessness[36] in the school administration system, while at the same acknowledging their de-facto autonomy[37] in the classroom. As part of their participation in the PLC, teachers were exercising their role as public intellectuals, particularly in a culture where teachers are not always viewed as career professionals.

35 NCERT is the apex national body for curriculum design, education research and training. DSERT is the state equivalent institution of NCERT.

36 Teachers are often caught between the demands of the system and the conflicting needs of the context they are a part of. While students lack basic competencies, the Education Department requires that teachers transact a uniform syllabus without the kind of flexibility that might allow them to interpret the curriculum for multiple learning levels.

37 While teachers have very little official authority, for all practical purposes, given the size and scale of the government school system, teachers do not face much interference with respect to their everyday teaching tasks.

An interesting consequence of the PLC has been the emergence of newer mobile-based communities that have been spontaneously created by teachers, using mobile phone applications such as WhatsApp, Telegram and Hike. Teachers found the mobile phone groups to be easier and more effective for sharing photographs and messages than the mailing lists. The mobile phone groups had smaller membership numbers which allowed for more focused discussions, on topics identified as interesting. A survey to collect information on mobile-based communities reveals that more than 50 such groups have been formed across the state, based on subject of interest and/or location of teachers. The COA processes which emphasized an open environment for sharing and creating seems to be correlated with the emergence of the mobile forums.

6.2.3 Techno-pedagogical challenges

6.2.3.1 Sustainability of KOER portal publishing

The publishing of resources on the KOER English and Kannada portals by teachers largely took place via the COA workshops, and was not happening on an ongoing basis beyond workshops by COA teachers working in their school settings or homes, as was originally envisaged. Most of the edits on the wiki portal was clustered around the workshop days. Publishing on the KOER platform appears to be academically and technologically complex. Teachers expressed that they were unable to populate the MediaWiki and sought more seamless methods to populate it from the mailing lists and mobile telephone communities. Infrastructural challenges posed by poor connectivity have also made KOER publishing challenging.

6.2.3.2 Quality of OER

One of the indicators of an effective OER model is the quality of resources produced. Analysis of the materials produced and shared suggests that the materials appear to be meeting the requirements of teachers, which is one dimension of quality.[38]For instance, the most commonly sought, created and shared resources on the mailing lists were question papers; question-paper pages were also the most viewed pages on the KOER portal. During the focus group discussions, COA teachers mentioned that question papers were required by all teachers, to provide practice for their students to prepare for the examinations.

However, some COA teachers openly expressed their dissatisfaction with OER that only seek to meet the basic needs of teachers, such as question papers for summative assessments. They felt that such materials only reinforced existing teaching practices without a critical pedagogy approach. This dissonance can be useful in encouraging teachers to reflect on the kind of OER that would support the progressive pedagogies required by national curricular policy, such as approaches based on the philosophy of constructivism.

During the focus group discussions, teachers expressed the need for credible, authentic, high quality materials, even while acknowledging exemplars of high quality resources amongst their group as well as in the PLC. This could be a useful point of departure to address two aspects: their sense of agency as developers of curricular materials and their articulated need for their own development that could facilitate the development of quality materials.

However, some also emphasized that the resources on KOER needed an review; perhaps teachers were used to receiving resources from the department and were unsure about the value of the materials created by them.

The large volumes of materials shared on mailing lists and the KOER website has meant that only a very small sample has been formally checked for quality assurance purposes. One of the expectations of the Education Department was that teachers would peer review the resources uploaded to the KOER portal, and use MediaWiki functionality to continually edit and revise the content. Such continuous peer editing and revision of resources is a higher order skill not yet seen on KOER. Acknowledging that more formal structures are required for review processes, DSERT is considering setting up state and district resource groups of teachers and teacher educators to play the role of peer reviewing and revising OER.

38 The ROER4D Research Concepts note mentions “fitness of purpose” as one determinant of quality.

6.3 Influence of the COA programme upon socio-cultural factors

The influence of the COA processes upon the socio-cultural factors has been analyzed in terms of the following:

1. Understanding of copyright issues (legal aspects)
2. Contextually relevant resources

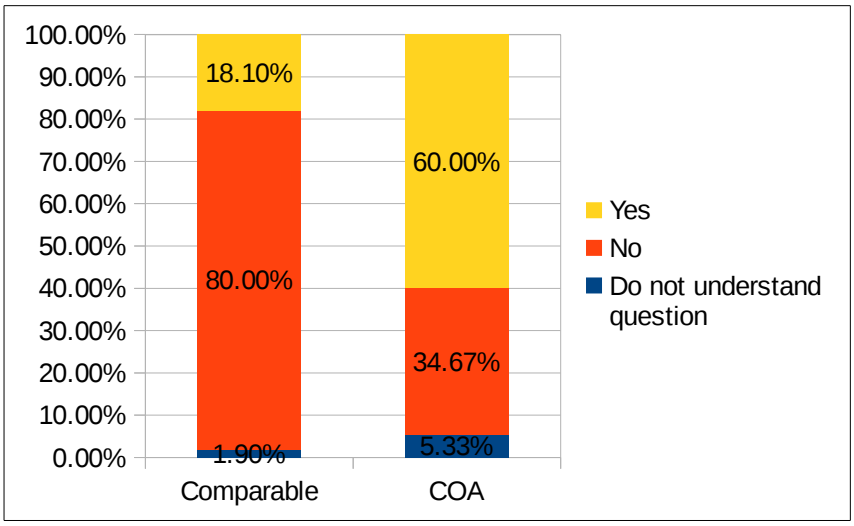
6.3.1 Understanding of open licensing

In the public school system, textbooks and other curricular resources are largely produced by the Education Department and made available for free to the teachers and students.

As part of the KOER project, the COA teachers were introduced to the idea of open licensing and creative commons, including training on how to identify open licensed content for reuse. This was a new concept and teachers' awareness about copyright was ascertained through the structured questionnaire.

23.Table: Awareness of copyright

Are you aware of copyright?	**Comparable**	**Percentage**	**COA**	**Percentage**
Yes	19	18.09%	45	67.16%
No	69	65.71%	18	26.87%
No response	17	16.19%	4	5.97%
Total	105		67	



COA teachers reported higher awareness of copyright. However, even amongst COA teachers, more than a quarter of teachers reported to be unaware of copyright, though in the COA workshops, they were made aware of OER licensing. It is significant that while 75% of COA teachers reported collaborating to create resources, they did not appear to be aware of the licensing framework that would support the collaboration.

One reason for this could be that the teachers are perhaps used to educational resources being "free" in the public education system. During the focused group discussions, it also emerged that teachers found the default copyright clause counter-intuitive, especially in the context of online digital resources, since these were usually easy to download and re-use, and were mostly gratis. Copyright on online content seemed

easier to understand for paid content. Teachers however appreciated the importance of open licensing and, as we saw earlier, instinctively argued for OER for the public education system.

6.3.1.1 "Implicit" OER

This brings us to an important observation about the understanding about resources in the context of the Indian education system. We observed during the study, that both the COA ad the STF PLC teachers prepared learning resources. The resources were shared on the PLC mailing lists, often with an explicit request for reuse or feedback, or even a request for the material to be shared via the KOER website. While articulating the objective of reuse, revise and remix, the teachers did not explicitly license the resources. It appeared that teachers treated the resources created by them and shared on mailing-lists as self evidently open. Rajaram Sharma ((Vignettes of Selected Asian Experience. WOU Press. 2016. Edited by G. Dhanarajan, page 57), in his case study on the STF-KOER programme, states:

> Public education in India is totally managed through state funds. State functionaries rarely engage with issues of copyright. Traditionally, publications of any kind including textbooks are funded by the state, rarely sold, even then at grossly subsidized costs and almost always covers the entire population. Educational resources are de-facto treated as open, with states encouraged to freely share, adapt and reproduce materials developed by each other.
>
> Also, typically, these are produced involving a large number of people drawn from different specializations within the education system. Outsourcing is only for printing or logistics. In the absence of private participation, the need for explicit stating and ensuring enforcement of legal rights (meaning copyright) has never been recognized. (p. 5)

In the ROER4D "Research Concepts" document (ROER4D Research Concepts Note),it is suggested that the term "creation" in the context of OER be referred to as the production of digital teaching and learning resources that are intended from the outset to be shared openly and under some form of licence that allows reuse – teaching and learning resources that are "born open". In the case of COA teachers, the first condition ("that [they] are intended from the outset to be shared openly") is satisfied, but the second condition ("under some type of licence that allows reuse") is not; even though these specially created resources were clearly intended to be "born open".

An analysis of 163 resources shared on the STF PLC by the teachers (both the COA and PLC teachers) reveals a majority of them have been sent with the intent of making them OER.,

24.Table: Mail analysis by nature of OER

Nature of resource based on copyright	**Number**	**Percentage**
Explicit non-OERs	3	1.84%
Implicit non-OERs	0	0.00%
Implicit OERs	144	88.34%
Explicit OERs	16	9.82%
Total	163	100.00%

These resources have either been created from scratch, or revised from other resources shared by other teachers. Resources accessed on the internet many of which have the traditional "All rights reserved"

copyright provisions have been called ("explicit non-OER") and those accessed on the internet which are openly licensed have been classified as ("explicit OER"). Implicit OER was used to refer to those materials which were subject to copyright but shared on the PLC (for example, PDFs of books).

This presented a disjunct between legal practice (where the default copyright provision is "All rights reserved") and social practice (where a resource can be legally shared and reused) is an issue that needs further work – not only from a research perspective, but also in terms of policy advocacy.

6.3.2 Contextually relevant resources

6.3.2.1 OER to respond to the teachers' and learners' contexts

Acknowledging the changing x context of their work, the COA teachers articulated their training and resource needs in terms of content knowledge, teaching and learning practices, and assessment techniques. This was particularly acute in view of the revised textbooks and the newly introduced method of Continuous and Comprehensive Evaluation[39] (CCE). In a textbook culture, where the only resource accessible and considered necessary was the textbook, they expressed an opinion that thee new textbooks were not adequate, and that they required reference books for subject enrichment.

Teachers outlined the difficulties in enabling student learning in the face of changing culture of learning (e.g. lower student responsiveness to teachers, reducing attention spans of students) and changes in parents' expectations (e.g. many parents desire that their children should speak English fluently, though there is little or no input from home to support this, especially in the context of rural government schools as well as urban, marginalized populations.

COA teachers were keen to create resources that could be more easily grasped by their students. Students in the high schools often had many learning gaps and the recently revised textbooks was were not accessible for many of them. A group of COA teachers came together to create foundational materials for mathematics learning to address the learning levels of the students entering high school at grade 8.

Content analysis indicates that the KOER English and Kannada portals were populated with materials to respond to these requirements through the provision of classroom activities for CCE, examination question papers, formative assessment activities, and grade computation sheets. Question papers in mathematics, science and social sciences have had some of the highest page views on the KOER portals (Appendix E). Focusing on strengthening the science lab as a method of teaching learning, the COA group of teachers created (from scratch) 25 Kannada video resources for demonstration of various science concepts, which formed the core resource material for a state-wide training programme.

Traditionally, material preparation and provision has almost exclusively been the responsibility of the DSERT; in this case teachers identified their own requirements and collaborated to create the materials required. Department officials (during the key informant interviews) appreciated the concept of teachers creating resources for themselves, since this would help them address their local needs. At the same time, they did mention that digital technologies would also enable the "good quality" content created by "expert" teachers would be available to other teachers, this was even better than the notion of all teachers creating OER. All teachers may not be able to, or be interested in creating OER was their view. There was also a view that easy availability of OER would encourage teachers to become lazy and not invest in making materials themselves.

39 Continuous and Comprehensive Evaluation is a new approach to assessment required by the state education policy. See: http://www.thehindu.com/news/cities/bangalore/continuousevaluationforclasses1to9infrom thisyear/article3602982.ece

6.3.2.2 OER creation in the local language

An important issue that came in the focus group discussions was the availability of OER in local language. Teachers also talked about the relative unavailability of OER in the local language, impacting OER adoption.

Kannada is the state language of Karnataka, spoken by most of its six million inhabitants, and also the medium of instruction in 65% of the high schools in the state. (Analytical report, 2012. Table 12A, page 16).

While Kannada Wikipedia was an important OER for teachers to access, the resources in Kannada Wikipedia is 0.34% of the wiki pages in English Wikipedia (See table 25), which can be seen as a proxy for the relative shortage of online open educational resources in the Kannada language. In this context, teacher creation of local language OER becomes more important; the percentage of Kannada resources on KOER as a percentage of English resources is 68%. This suggests that teachers see the COA process as a method of creating OER in local languages.

While the wikipedia is also a collaborative OER platform, it is interesting to see the difference in the percentage of local language content between KOER and the Wikipedia. The KOER Kannada : English content ratio is 200 times that of Wikipedia. One reason for this substantial difference could perhaps be that the COA teachers, populating KOER, are a coherently defined community, of practising teachers, creating OER to respond to their immediate professional needs. Teachers also feel a sense of ownership over the KOER website, which has the "for the teachers, of the teachers and by the teachers" tag-line.

25.Table: KOER statistics (English KOER and Kannada KOER websites, 30 September 2015)

Analytics category	**Kannada KOER**	**English KOER**	**Ratio of Kannada to English**
Web pages	3,000 +	4,400+	68.18 : 100
Resource files uploaded	1,500 +	2,500+	60.00 : 100
	Kannada Wikipedia	**English Wikipedia**	
Number of articles	16,500 +	4.9 million+	0.34 : 100

Note: KOER statistics was generated by using the "Special pages" (reports) feature of MediaWiki. The special pages can be viewed by clicking on the "Special pages" link on the KOER home page (in English[40] and in Kannada[41]). This data was generated using the "Statistics" feature. The Wikipedia data on articles in English and Kannada languages was generated from the Wikipedia "List of Wikipedia". Appendix E provides the views for the top 20 pages in KOER English and Kannada.

While the availability of local language resources has been positively influenced due to the COA processes, English OER pages are more than the Kannada pages.

One reason for this could be that technical writing is easier in the language in which teachers have studied. In Karnataka, mathematics and science teachers need to have a graduate degree in science (a Bachelors of Science, or BSc.), which is offered in the English medium in universities across Karnataka because of which these teachers preferred to create OER in English. These teachers, because of their bilingual competence in reading and writing English and Kannada, could also access more OER for reuse. On the other hand, social

40 See http://karnatakaeducation.org.in/KOER/en/index.php/Special:Statistics

41 See http://karnatakaeducation.org.in/KOER/index.php/ವಿಶೇಷ:Statistics

science teachers whose graduate degree in Humanities (Bachelors of Arts, or BA), was often in the Kannada language, preferred to create OER in Kannada. The OER access and reuse by the social science teachers was also limited as many were not as comfortable in reading or writing in English.

This pattern is also borne out in the mailing-list interactions studies. In this sense, there seems to be a relationship between subject taught, language of interaction, and language of resources created.

COA teachers mentioned that they required that resources be in the different languages of students, and mentioned that teacher ability to transact in multiple languages needed to be developed, since in many schools students come from different linguistic backgrounds and in a single class more than one language may be spoken at home. One of the COA teachers, who taught in an Urdu-medium high school, translated some mathematics resources shared by other COA teachers into the Urdu language (Arabic script) and shared these on the mailing list. After Kannada and English, Urdu is the third most popular medium of instruction in government high schools across the state. This suggests that an OER adoption model embedded within the public education system has the potential to influence OER creation in local languages, making it possible for the OER model to be scaled and replicated in other states.

6.4 Surprises

The emergence of the STF PLC as a space for OER sharing and adoption was a surprise. While there was no benchmark for virtual interaction amongst teachers in a public education system in a developing country, the poor availability of ICT infrastructure, the low competency levels of teachers in terms of adopting digital processes, and the complexity of a large public school system had kept expectations quite low. The high volume of emails on the PLC and the response of the COA members to access these resources and publish on the KOER website also was a welcome surprise for the research team.

The extent to which the COA teachers were receptive to the idea of a collaborative OER adoption was a surprise. The participation in the workshops was not mandatory, and many teachers had to negotiate with their school head masters to be allowed to attend. Teachers would pro-actively share their preferences of dates for holding the workshops with the research team, indicating their willingness to attend. Besides their participation, they actively recommended additional members for inclusion in the process. In the context of a strongly hierarchical Indian education system, such initiative was a surprise for the research team.

7 Conclusion: “Professional Learning Communities” - a systemic model for OER adoption and TPD in the public education system

In the large public education system in India, as elsewhere, teachers have traditionally been isolated. Schools tend to be geographically dispersed and often there is only one subject teacher per subject in each school. Teachers rarely have an opportunity to meet with other teachers teaching the same subject. Generally, traditional teacher development processes tend not to offer much scope for interaction and peer learning (Rothberg, 1985). This research project has demonstrated that virtual networks can offer opportunities for teachers to connect with one another for peer sharing and learning. Such a professional learning community (PLC) can also be a space for OER access and adoption, which can counter the ‘minor technician’ role expected of a teacher by the education bureaucracy. A collaborative OER adoption model embedded within a PLC, can both provide the context for the community to come together and support a systemic model of OER adoption within the public education system. A free and open digital environment can encourage teachers to freely explore and connect digital means (FOSS) and ends (OER).

Teachers have found the creation, revision, remixing and redistribution of resources on mailing lists and the KOER website both interesting and useful. This has had a positive impact on their digital habits and has

affected the techno-social habits of the teachers in Karnataka. It has also supported their professional development, as is evidenced by their reflections on the learning that has taken place through community interaction. The nature of these discussions has enabled teachers to see the value of an on-line community for accessing and sharing resources.

7.1 Embedding OER adoption in the public education system

The size of the public education system in Karnataka (comprised of 4,500 government high schools and 37,000 teachers) has helped to create a sufficient volume of interaction in the PLC. The size of the public education system is usually been seen as a limitation or a weakness by the teachers. However, it is possible that the networking of teachers using digital technologies can help to see the large size of the system as a strength, as the large number of teachers participating in the network could be a benefit in terms of the volume of OER created and shared by them. Even if only a very small percentage of teachers from the public education system participate, in absolute numbers, it is likely to be large enough to provide a base for OER creation and adoption.

As the Subject Teacher Forum and the Karnataka Open Educational Resources programmes have been designed and conducted by the state school education system utilising departmental budgets for teacher education, the model of collaborative OER adoption can be scaled and implemented in other states. The Ministry of Human Resource Development, Government of India (2014) (responsible for education at the federal level) has recommended the STF-KOER programme as good practice, and two state governments, those of Telangana and Assam, have initiated discussions on similar programmes in their states[42].

7.2 Policy recommendations

The following immediate policy recommendations have arisen from the research process:

7.2.1 Implement PLC approach to TPD in in-service teacher education

The PLC model of TPD, as implemented in the STF programme, provides opportunities for self-learning, peer learning and continuous learning, which are key requirements of the National Curricular Framework for Teacher Education, 2010. Since this model utilises available resources and budgets of the education system, implementing a similar programme in other states in India, would be quite possible; state and district level ICT infrastructure will, however, need to be developed and maintained in order to facilitate teacher training. A PLC would also provide the context for a sustained OER adoption program.

7.2.2 Implement the COA model for OER adoption

Bringing teachers together in collaborative OER creation and sharing processes can help the creation of contextual OER, including those in Indic languages. This can provide resources that complement and supplement the textbook, currently the primary curricular resource of the teacher, in the Indian education system. However, continuous peer editing and revision of resources will require more formal structures and processes to be established, to ensure quality of processes and outputs.

7.2.3 Copyright policy should make open licensing as the default

One important step in promoting OER adoption would be to have a policy in which the default copyright treatment for any work would be open licensing. This would facilitate legal permissions upfront for newly created /materials and legal reuse, revision, remixing and redistribution. Anyone who intends to prevent sharing or modification must require it, by explicitly stating ‘All rights reserved”. This is a recommendation

42 Appendix H provides letters from these two states

for policy, but the fact that most countries have "All rights reserved" as the default copyright expression means that this would require long-term effort.

7.2.4 Implement a free and open technology environment

The "National Policy on ICT in School Education" (2012) recommends the use of FOSS. India is one of very few countries in the world that has a policy on adopting open standards (Policy on Open Standards for e-Governance, 2010) for digital files in public institutions (by which proprietary document formats are not to used). Given the numerous advantages of the FOSS environment over a proprietary environment, these policies need to be fully implemented. Usually the apprehensions about mandating FOSS relate to perceived difficulties in implementation, and not to the concept itself. The experience in implementing FOSS in Karnataka as part of the STF programme, and earlier in Kerala (Kasinathan. 2009), suggest that it is possible to implement a FOSS-based ICT programme in school education. Since software applications are the means by which OER can be adopted, mandating FOSS would support OER adoption by greater alignment at the philosophical level.[43]

7.3 Possible next steps for research

A model of bottom-up, collaborative approach for teachers to create, reuse, revise, remix and redistribute OER has been evidenced through this study. There are, however, a few important areas that require further investigation.

1. Firstly, there is a need to study the influence of the PLC on the COA. While the COA teacher interactions with the PLC have been studied and discussed, a study of the interactions amongst the PLC teachers would be useful in terms of providing a better understanding of the COA model studied in this project, since the COA effectiveness is partly due to it being embedded within the PLC.
2. Secondly, the actual use of the materials by teachers, for both for their TPD and in their teaching, needs to be studied, as insight into which materials are deemed useful can help in understanding OER use with respect to TPD and student learning. This would support the further maturation and evolution of the collaborative model of OER adoption.
3. Thirdly, taking this programme to other states in India would help it mature as a mainstream model for OER adoption in India, which other public education systems in the global South could explore.

Apart from these steps, it is necessary to create an awareness amongst teachers who share resources with the intention that others will reuse, revise, remix and redistribute to explicitly use open licensing. This will enable the teachers who are reusing these materials as OER, to be compliant with copyright law.

43 See http://roer4d.org/1570 for a blog by ITfC ROER4D research team member, making this argument

8 References

Albright, P. (2005). Final forum report. *internet Discussion Forum: Open Educational Resources, Open content for higher education*, International Institute for Educational Planning. Retrieved from http://www.unesco.org/iiep/virtualuniversity/media/forum/oer_forum_final_report.pdf

Analytical_Report, Karnataka Education Department, Retrieved from http://www.schooleducation.kar.nic.in/databank/201112_Analytical_Report.pdf

Camilleri, A.F., Ehlers, U.D. & Pawlowski, J. (2014). State of the art review of quality issues related to Open Educational Resources (OER). *JRC Scientific and Policy Reports.* Seville, Spain: Joint Research Centre, European Commission. Retrieved from http://is.jrc.ec.europa.eu/pages/EAP/documents/201405JRC88304.pdf

Deepika, K.C. (2012, July 5). Continuous evaluation for classes 1 to 9 in from this year. *The Hindu*. Retrieved from http://www.thehindu.com/news/cities/bangalore/continuous-evaluation-for-classes-1-to-9-in-from-this-year/article3602982.ece

Deimann, M. & Farrow, R. (2013). Rethinking OER and their use: Open education as Bildung. *The International Review of Research in Open and Distributed Learning, 14*(3). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1370/2542

District Information on School Education, Ministry of Human Resource Development, Government of India. Retrieved from http://dise.in/Downloads/Publications/Documents/U-DISE-SchoolEducationInIndia-2013-14.pdf

Department of School Education and Literacy, Ministry of Human Resource Development, Government of India. (2012). *National policy on Information and Communication Technology (ICT) in school education.* New Delhi, India. Retrieved from http://www.itforchange.net/sites/default/files/ITfC/revised_policy document ofICT.pdf

Eisner. 1991. What Really Counts in Schools. Educational Leadership, february, pp. 10-11. Retrieved from http://academic.wsc.edu/education/curtiss_j/eisner.htm

Ferreira, G. (2008). What about the teacher? Open Educational Resources et al. In *EADTU 2008 Conference*. Poitiers, France.

Gauntlett, D. (2002). *Media, gender and identity: An introduction*. London and New York: Routledge.

Giddens, A. (1984). *The constitution of society: Outline of the theory of Structuration*. Cambridge: Polity Press.

Giddens, A. (1993). *New rules of sociological method: A positive critique of interpretative sociologies* (2nd ed.). Stanford, CA: Stanford University Press.

Gilmore, T., Krantz, J. & Ramirez R. (1986). Action based modes of inquiry and the host-researcher relationship. *Consultation, 5*(3), 160-176. Retrieved from http://www.researchgate.net/publication/232603154_Action_Based_Modes_of_Inquiry_and_the_Host-Researcher_Relationship

Hatakka, M. (2009). Build it and they will come? - Inhibiting factors for reuse of open content in developing countries. *The Electronic Journal on Information Systems in Developing Countries*, 37(5), 1-16. Retrieved from http://www.ejisdc.org/ojs2/index.php/ejisdc/article/viewFile/545/279

Hylen, J., Damme, D.V., Mulder, F. & D'Antoni, S. (2012). Open Educational Resources: Analysis of responses to the OECD country questionnaire. *OECD Education Working Papers*, 76. DOI: 10.1787/5k990rjhvtlv-en.

ICT Schools evaluation, 2015. by Central Institute of Education Technology, NCERT. Retrieved from http://www.slideshare.net/GurumurthyKasinathan/ictschools-evaluation-by-ciet-ncert-karnataka2015

Matthew R. Jones, M.R. & Karsten, H. (2008). Giddens's Structuration Theory and Information Systems Research. *MIS Quarterly, 32*(1), 127-157. Retrieved from http://www.jstor.org/stable/25148831

Kanwar, A., Kodhandaraman B. & Umar A. (2010). Toward sustainable Open Education Resources: A perspective from the Global South. *The American Journal of Distance Education, 24*(2), 65-80. DOI: 10.1080/08923641003696588.

Kasinathan, G . (2009). *ICTs in school education – Outsourced versus integrated Approach, Policy brief.* Bengaluru, Karnataka: IT for Change. Retrieved from http://www.itforchange.net/sites/default/files/ITfC/Policy_Brief_on_ICTs_in_School_Education_from_IT_for_Change_August_2009.pdf

Kasinathan, G . (2009). *Computer learning programmes in schools - Moving from BOOT models to an integrated approach.* Bengaluru, Karnataka: IT for Change. Retrieved from http://itforchange.net/BOOT_Integrated

Kumar, K. (1988). Origins of India's "textbook culture". *Comparative Education Review 32*(4), 452-464. Retrieved from https://www.jstor.org/stable/1188251?seq=1#page_scan_tab_contents

Lane, A. (2008). Widening participation in education through Open Educational Resources. In T.Iiyoshi and M.S.V. Kumar (Eds.), *Opening Up Education: The Collective Advancement of Education through Open Technology, Open Content, and Open Knowledge* (149-163). Cambridge: The MIT Press. Retrieved from https://mitpress.mit.edu/sites/default/files/titles/content/9780262515016_Open_Access_Edition.pdf

Ministry of Human Resource Development, Government of India. (2014). *Rashtriya Madhyamik Shiksha Abhiyan: Third Joint Review Mission, Aide Memoire*. Retrieved from http://mhrd.gov.in/rmsa_jrm

Mishler, E.G. (1979). Meaning in context: Is there any other kind?. *Harvard Educational Review, 49*(1), 1-19. DOI: http://dx.doi.org/10.17763/haer.49.1.b748n4133677245p

Mishra, P. & Koehler, M.J. (2006). Technological Pedagogical Content Knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054. Retrieved from http://punya.educ.msu.edu/publications/journal_articles/mishra-koehler-tcr2006.pdf

National Council of Educational Research and Training. (2005) *National Curriculum Framework*. New Delhi, India. Retrieved from http://www.ncert.nic.in/rightside/links/pdf/framework/english/nf2005.pdf

National Council of Teacher Education. (2010). National Curricular Framework for Teacher Education. Retrieved from http://ncte-india.org/ncte_new/pdf/NCFTE_2010.pdf

National policy on ICT in School Education. (2012). Retrieved from http://mhrd.gov.in/sites/upload_files/mhrd/files/upload_document/revised_policy%20document%20ofICT.pdf

National policy on Education. (1986). Retrieved from http://mhrd.gov.in/sites/upload_files/mhrd/files/upload_document/npe.pdf

DISE. National University of Education Planning and Administration. Retrieved from http://dise.in/Downloads/Elementary-STRC-2014-15/All-India.pdf

DISE. National University of Education Planning and Administration. Elementary Education Report Card 2014-15. Retrieved from http://dise.in/Downloads/Elementary-STRC-2014-15/All-India.pdf

DISE. National University of Education Planning and Administration. Secondary education: Secondary Education : Flash Statistics: 2014-15. Retrieved from http://dise.in/Downloads/Publications/Documents/SecondaryFlash%20Statistics-2014-15.pdf

Daniel & Uvalic-Trumbic. 2012 Daniel, Sir J. & Uvalić-Trumbić, S. (2012). Fostering Governmental Support for Open Educational Resources Internationally, 6th REGIONAL POLICY FORUM ARAB REGION, Oman, 7-8 May 2012. Available online: http://www.col.org/resources/speeches/2012presentations/Pages/2012-05-07.aspx

National Policy on Information and Communication Technology in School Education" (Government of India, 2012). Retrieved from http://mhrd.gov.in/sites/upload_files/mhrd/files/upload_document/revised_policy%20document%20ofICT.pdf

Ngimwa, P. & Wilson, T. (2012). An empirical investigation of the emergent issues around OER adoption in Sub-Saharan Africa [Abstract]. *Learning, Media and Technology, 37*(4), 398-413. DOI: 10.1080/17439884.2012.685076.

Okada, A. (2010). Reusing Educational eContent: http://labspace.open.ac.uk/course/view.php?id=5571

Petrides, L., Jimes, C., Middleton-Detzner, C. & Howell, H. (2010). OER as a model for enhanced teaching and learning. In *Open Ed 2010 Proceedings*. Barcelona: UOC, OU, BYU. Retrieved from http://openaccess.uoc.edu/webapps/o2/bitstream/10609/4995/6/Jimes_editat.pdf.

Public Report on Basic Education (PROBE) report. 1998. UNDP. Retrieved from www.undp.org/content/dam/india/docs/public_report_basic_education_india.pd

Right of Children to Free and Compulsory Education Act, 2009. Retrieved from http://librarykvpattom.files.wordpress.com/2010/04/india_education_act_2009.pdf

ROER4D Research Concepts Note. Retrieved from ROER4D portal https://docs.google.com/document/d/1Iz1kVC4CYLFJBtZNm2o5ziFJKW96SjtNjhWHfTKKkbI/edit

Rothberg, R.A. (1985). Improving school climate and reducing teacher isolation [Abstract]. Retrieved from http://eric.ed.gov/?id=ED270855.

Sapire, I. & Reed, Y. (2011). Collaborative design and use of open educational resources: a case study of a Mathematics teacher education project in South Africa. *Distance Education for Empowerment and Development in Africa*, *32*(2), 195-211. DOI: 10.1080/01587919.2011.584847.

Sarva Shiksha Abhiyaan, 2008. retrieved from http://pib.nic.in/archieve/others/2008/apr/r2008042401.pdf

Scheffler, I. (1973) *Reason and Teaching*. London: Routledge & Kegan Paul Ltd.

Sharma, R. . Subject Teacher Forums and the Karnataka Open Educational Resources Programme - A Case Study, in Vignettes of Selected Asian Experience. WOU Press. 2016. Edited by G. Dhanarajan. ISBN 978-983-3910-02-1 (ePub)

Stacey, P. (2010). Government support for open educational resources: policy, funding, and strategies. *The International Review of Research in Open and Distributed* Learning, *14*(2). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1537/2481

Thakur. 2014. ICT and Digital Divide in Indian School System. Retrieved from http://*ijims.com*

Vespignani, A. (2009). Predicting the Behavior of Techno-Social Systems. *Science*, *325*, 425-428. Retrieved from https://www.researchgate.net/publication/26692140_Predicting_the_Behavior_of_Techno-Social_Systems_

Wiley, D., Green, C. & Soares L. (2012). Dramatically bringing down the cost of education with OER: How Open Education Resources unlock the door to free learning. Center for American Progress. Retrieved from https://www.americanprogress.org/wp-content/uploads/issues/2012/02/pdf/open_education_resources.pdf

Wright, C.R. & Reju S.A. (2012). Developing and deploying OERs in sub-Saharan Africa: Building on the present. *The International Review of Research in Open and Distance Learning*, *13*(2), 181-220. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1185/2161

9 Appendices

26. Appendix A – Workshops with COA group of teachers

No	Month Year	Subject	Particulars	FGD topic
1	July 2013	Science	Collaborative creation of OER	No FGD held
2	July 2013	Mathematics	Collaborative creation of OER	No FGD held
3	Aug 2013	Science	Collaborative creation of OER	No FGD held
4	Sept 2013	Social Science	Collaborative creation of OER	No FGD held
5	Sept 2013	Mathematics	Collaborative creation of OER	No FGD held
6	Nov 2013	Social Science	Collaborative creation of OER	No FGD held
7	Feb 2014	Mathematics	Collaborative creation of OER	No FGD held
8	Feb 2014	Social Science	Collaborative creation of OER	No FGD held
9	Feb 2014	Science	Collaborative creation of OER	No FGD held
10	11 July 2014	Mathematics	Collaborative creation of OER	Role of resources (teaching learning materials) in TPD
11	17 July 2014	Social Science	Collaborative creation of OER	Role of resources (teaching learning materials) in TPD
12	24 July 2014	Science	Collaborative creation of OER	Role of resources (teaching learning materials) in TPD
13	14 Aug 2014	Mathematics	Collaborative creation of OER	Challenges in collaborative resource creation
14	27 Aug 2014	Science	Collaborative creation of OER	Challenges in collaborative resource creation
15	5 Nov 2014	Social Science	Collaborative creation of OER	Challenges in collaborative resource

				creation
16	Feb 2015	Mathematics and Science	Collaborative creation of OER	Feedback and sharing on the STF community and on KOER website, phone based virtual interactions
17	Feb 2015	Social Science	Collaborative creation of OER	Feedback and sharing on the STF community and on KOER website, phone based virtual interactions
18	June 2015	Science	Collaborative creation of OER	Resource creation processes and TPD
19	Aug 2015	Mathematics	Collaborative creation of OER	Resource creation processes and TPD

27. Appendix B – Structured questionnaire to COA and Comparable groups

No	Date	Subject	Group	District	Number of participating teachers
1	1 July 2014	Maths	Comparable	Bangalore Urban Phase-3	27
2	2 July 2014	Science	Comparable	Bangalore Urban Phase-3	22
3	3 July 2014	Social Science	Comparable	Bangalore Urban Phase-3	28
4	3 Sept 2014	Maths	Comparable	Yadgiri	15
5	4 Sept 2014	Science	Comparable	Yadgiri	17
6	6 Sept 2014	Social Science	Comparable	Yadgiri	15
		Total			**124 (of which 105 responses were usable)**
1	11 July 2014	Maths	COA	All over state	26
2	17 July 2014	Social Science	COA	All over state	23
3	24 July 2014	Science	COA	All over state	18
		Total			**67**

Note- 19 of the Comparable group teacher responses were not usable. Hence the number of Comparable teachers, whose responses have been considered, is 105.

28. Appendix C – Focus group discussion topics

The focus group discussions held for the COA group of teachers in July 2014, and for the Comparable group teachers - Bangalore Urban in July 2014, and Yadgir district during September 2014, covered the following broad topics

No	question	Probes - open-ended discussions
1	What are the challenges you face in meeting your	Availability of resources, peer interactions, interactions with experts / teacher educators, time

	learning needs?	
2	Role of resources in teaching	Role of 'textbook' as given/specified resource (textbook culture Prof Krishna Kumar), processes of 'materials reconstruction' (collaborative development/ adaptation), Knowledge acquisition – active engagement spectrum.
3	How do you decide a resource is good?- Notion of 'quality' of a resource	Understandable language, relevant context, complete, comprehensive, brief or appropriate length, appropriate words used,
4	Teacher Professional Development	How do you see your role in TPD Connection between the educational resources available and the teaching-learning methods adopted by teachers - support do you need for developing as a teacher professional / teachers need for developing as teacher professionals Do you think teachers groups / communities can support teacher development? How teacher agency (how confident do I feel about negotiating about negotiating) Teacher esteem – how do I feel about my role as a teacher and recognition from society
5	Current structures and processes- What are your views on current methods of teacher training	Open ended discussion. Probes – need assessment, material preparation, transaction, assessment, post programme interactions, active role for teacher in training
6	Collaboration amongst teachers	Open ended discussion. Probes – What are your current practices for sharing resources, seeking resources, offering feedback on resources What do you think about editing/changing another teachers contribution How can we give credit / authorship to a document created by many teachers

Other focus group discussions conducted for the COA teachers had much narrower agenda, and the discussion topic is provided in Appendix A.

29. Appendix D - List of the virtual forums

Name of the virtual forum	**Nature of the forum**	**Particulars**	**Accessible at**
mathssciencestf@googlegroups.com	Mailing list	Read – Public, open to all Write - All teachers who are part of STF program	https://groups.google.com/forum/#!forum/mathssciencestf
socialsciencestf@googlegroups.com	Mailing list	– Public, open to all Write - All teachers who are part of STF program	https://groups.google.com/forum/#!forum/socialsciencestf
KOER (English)	Web portal	Read – Public, open to all Write - All teachers who are part of KOER program	http://karnatakaeducation.org.in/KOER/en/index.php/Main_Page
KOER (Kannada)	Web portal	Read – Public, open to all	http://karnatakaeducation.org.in/

		Write - All teachers who are part of KOER program	KOER/index.php

The KOER website has two separate MediaWiki installations – one for English and one for Kannada. In each KOER, the Mathematics, Science and Social Science subject resources are available.

30. Appendix E – KOER web views

The statistics is available from KOER itself, through the special pages link (See http://karnatakaeducation.org.in/KOER/en/index.php/Special:PopularPages)

Karnataka Open Educational Resources Popular pages (page names)	**Views**
Maths: question Papers[44]	134795
Main Page	128290
Frequently Asked questions	53382
Text Books	32930
Subject Teacher Forum	25902
Kalpavriksha	22211
Science: question Papers	20229
Become a STF groups member	20219
Resource Book for MRP Cascade training - RMSA Subject Teachers Forum - IT for Change	19465
Cascade District Workshops for Mathematics 2014-15	19026
English: question Papers	16658
Public Software	12425
Assessment Framework Class X CCE	11368
Palanquin Bearers	10549
Why public software	10006
Social Science: question papers	9335
Mathematics Solved problems	9073
Circles	8864
STF Cascade District Workshops 2013-14	8854
Science: Curriculum and Syllabus	8188
Science: Topics	7762
Mathematics: Topics	7529
Text Books NCERT Mathematics	7009
See old STF mails	6496
STF 2013-14 Shimoga	6495
Grandma Climbs a Tree	6178
Karnataka D. Ed Curriculum Revision 2012	5910
Mensuration	5745
Energy	5418
Bacteria	5314
Coromandel Fishers	5312
There's a Girl by the Tracks!	5298

44 These are the actual page names, hence not changed or corrected.

KOER Mathematics 2014-15	5189
question Papers	5171
Errors in textbooks	4681
Class10 circles tangents problems	4530
Karnataka CCE	4489
Text Books NCERT Science	4468
Class X : Second Language	4418
Text books ncert social science	4367
Quadrilaterals	4357
Social Science: Topics	4235
Teacher education programmes 2014-15	4198
Index.php	4156
Life Processes	3938
Organisms	3932
Light	3865
Gravitation	3857
A hero	3823
Community	3717
Science Laboratory	3710
Circles and lines	3655
Cascade District Workshops for HTF 2014-15	3627
Social Science: Curriculum and Syllabus	3595
Laugh and Be Merry	3515
Organisation of cells plant tissues	3396
Cascade District Workshops for Mathematics 2013-14	3393
Triangles	3379
Science: Topics Electromagnetism	3346
New topic to be create	3340
Quadratic Equations	3308
Cascade District Workshops for Science 2013-14	3293
Koer wiki help	3216
The Village School Master	3149
Simulations	3123
Buy a laptop or netbook	3005
Science 2015-16 STF KOER workshops	2915
Topics by class	2908
Goodbye Party for Miss Pushpa T. S.	2888
Polynomials	2880
Fractions	2858
Graphs And Polyhedra	2789
Number Systems	2768

Progressions	2761
Green Plants and Chordates	2695
Hindi 2015-16 STF KOER workshops	2680
Maths topics by class	2656
Basics terms in circles	2640
STF 2013-14 Belgaum	2625
Geogebra Applets	2622
Cascade District Workshops for HTF 2013-14	2616
Ballad of the Tempest	2602
Polygons	2541
Introduction to ICT the computer	2537
Heat	2511
Surds	2498
Kannada Speaking Regions During Colonial Rule	2386
STF 2013-14 Udupi	2370
Circulars	2365
Cascade District Workshops Science 2015-16	2345
Old Circles	2320
Maths: Curriculum and Syllabus	2273
Solved problems	2227
Science: Pedagogy	2227
Gentleman of Rio en Medio	2202
Quality of Mercy	2167
The Enchanted Pool	2155
The Best Advice I Ever Had	2146
Introduction to KOER	2130

Note:

KOER statistics were generated by using the 'Special pages' (reports) feature of MediaWiki. These can be viewed by anyone by clicking on the 'special pages' link on the KOER home page (in English and Kannada).

Karnataka Open Educational Resources Popular pages (Kannada) name	**English translation**	**Number of views**
ಮುಖ್ಯ ಪುಟ	Home page	110,322 views
ಗಣಿತ: ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ ಗಳು	Mathematics question paper	12,403 views
ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳು	question paper	11,613 views
ಸಮಾಜ ವಿಜ್ಞಾನ ವಿಷಯಗಳು	Social Science topics	10,711 views
ಸಮಾಜ ವಿಜ್ಞಾನ: ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳು	Social Science question paper	9,774 views
ವಿಜ್ಞಾನ: ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳು	Science question paper	8,422 views
ವಿಜ್ಞಾನ ವಿಷಯಗಳು	Science topics	7,804 views

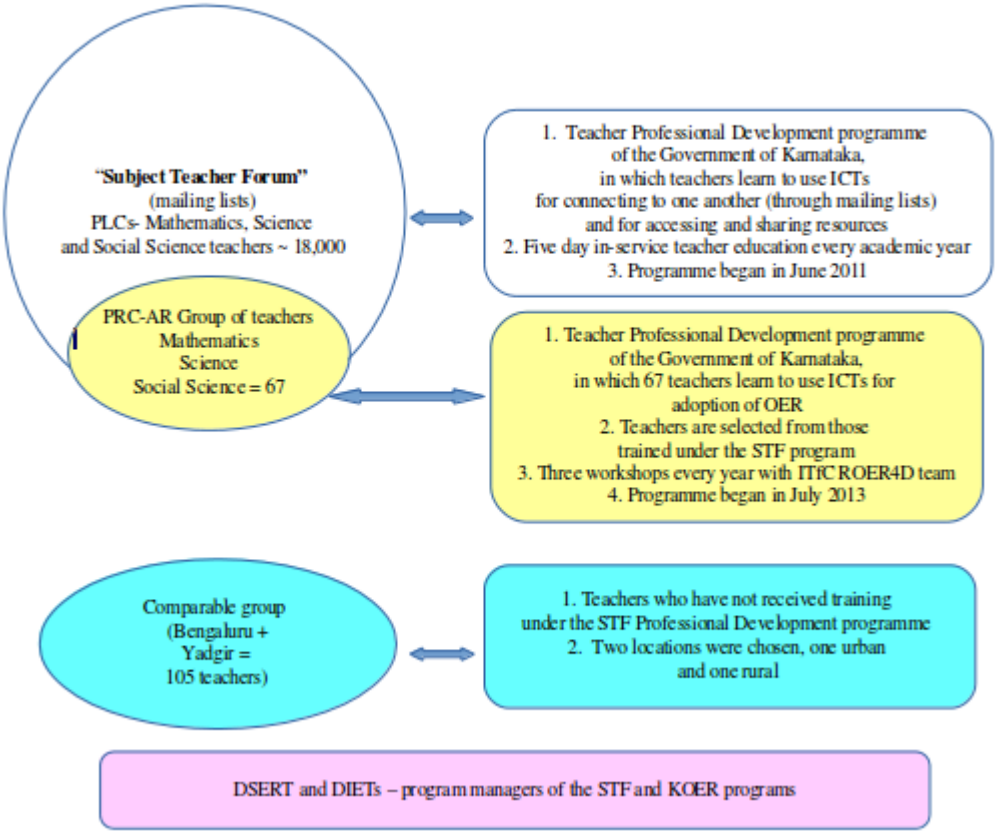
ಗಣಿತ: ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳು	Mathematics portal page	6,557 views
ವಿಷಯ ಶಿಕ್ಷಕರ ವೇದಿಕೆ ಜಿಲ್ಲಾ ಅನುಕ್ರಮ ಕಾರ್ಯಾಗಾರಗಳು2013-14	STF District workshop programme 2013-13	4,540 views
ಆಹಾರ	Food	4,185 views
ಕನ್ನಡ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳು	Kannada question papers	3,641 views
ವರ್ಗಗಳು :ಪಠ್ಯ ಪುಸ್ತಕಗಳು	Textbooks	3,500 views
ಸರ್ಕಾರಿ ಸುತ್ತೋಲೆಗಳು	Government circulars	3,499 views
ಆಧಾರಗಳು		3,434 views
ಗಣಿತ: ವಿಶಯಗಳು	Mathematics: topics	3,403 views
2014-15 ನೇ ಸಾಲಿನ ಶಿಕ್ಷಕರ ಶೈಕ್ಷಣಿಕ ಕಾರ್ಯಕ್ರಮಗಳು	2014-15 Teacher Education programs	3,119 views
ವಿಜ್ಞಾನ: ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳು	Science question papers	3,009 views
ಕನ್ನಡ: ವಿಷಯಗಳು	Kannada:topics	2,742 views
ತರಗತಿವಾರು ವಿಜ್ಞಾನ ವಿಷಯಗಳು	Class-wise Science topics	2,706 views

31. Appendix F – Free and open source tools learnt in COA programme

Area	**Public Software**
Operating system	Ubuntu GNU-Linux
Office Applications Text editor Spreadsheet Presentation	LibreOffice LibreOffice Writer LibreOffice Calc LibreOffice Impress
Email client	Mozilla Thunderbird
internet Browser	Mozilla Firefox / Google Chrome
Image editing	GIMP
Video editing	Openshot
Screencasting	RecordMyDesktop
Mind map	Freemind
Mathematics	Geogebra
Science	Phet, Kalzium, Kstars
Geography	Marble, K Geography

Appendix G – Graphic representation of the actors in the system

3.8 Graphic representation of the actors referred to in the study



Appendix H – Invitation from Assam and Telangana education departments

OFFICE OF THE MISSION DIRECTOR
RASHTRIYA MADHYAMIK SIKSHA ABHIJAN, ASSAM
Kahilipara, Guwahati-781019

RMSA/ICT/577/2015/1 **Dated: 26th August, 2015**

From:

R. C. Jain, IAS
Mission Director, RMSA
RMSA, Guwahati, Assam

To:

Dr. Tushar Rane
Chief Field Office
UNICEF

Sub: Regarding providing support to RMSA in the Subject Teacher Forum integrating ICT program in school education

Sir,

With reference to the captioned subject, National Curricular Framework for Teacher Education, 2010 (NCFTE) has proposed significant changes in teacher education, in terms of philosophy, context understanding, need, role and approaches. It recognized that "Teachers needs to be creators of knowledge and thinking professionals. They need to be empowered to recognize and value what children learn from their home, social and cultural environment and to create opportunities for children to discover, learn and develop." Hence, a Subject Teacher Forum program (STF) for Assam has been proposed to integrate ICT in education.

With UNICEF's active support received in previous endeavours of RMSA, we would like to request your support and direction which would be essential for the effectiveness and sustainability of this program as well. In this endeavour the support of 'IT for Change' will be taken as this organization has academic as well as extensive implementation experience. The concept note and the MOU (RMSA-ITfC) for the program have been attached for your reference.

We would be highly obliged if you would extend your support to RMSA in this regard.

Enclosure: As stated

Yours faithfully,

(R. C. Jain, IAS)
Mission Director
RMSA, Assam

PROCEEDINGS OF THE DIRECTOR OF SCHOOL EDUCATION, TELANGANA, HYDERABAD

Rc. No. 412/D/C&T/SCERT/2014, Dated: 27.07.2015

Sub: SCERT, Telangana, Hyderabad – ICT - Computer Education in Schools – Transacting school subjects using Information and Communication Technology (ICT) – Implementation of Computer Assisted Learning in High Schools – A workshop on 28th July, 2015 from 2.00 PM onwards in the conference hall of Directorate of School Education, Hyderabad – Request reg.

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It is inform that it is proposed to conduct a workshop on the implementation of computer education in the High Schools and to discuss programme design etc. on 28-07-2015 from 2.00 PM onwards duly inviting certain experts within the State and outside.

Therefore, I request you to kindly attend the workshop and participate in the deliberations and guide the implementation of computer education in the High Schools of Telangana State. The travel expenditure will be from SCERT.

(S. JAGANNATH REDDY)
for **Director of School Education**

To
Sri Gurumurthy, IT for Change, Bangalore.