

Professional Learning Communities, an ICT integrated model of in-service teacher education

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1 Background

Teacher education (TE) is accepted as an important factor in improving the quality of school education in India. The government of India has launched programs for supporting TE through SSA, RMSA and the Teacher Education programmes. However, in most part, the basic model of the teacher education has been of a centralised program design. It is seen necessary to ‘cover’ all the teachers in a state, this makes training to be of scale, supply driven and focused on reaching training targets. This leads to limited interaction amongst participants during training and amongst participants and with RPs after training.

The National Curricular Framework for Teacher Education¹ has outlined its vision for a TE, which is based on teachers’ developmental needs. It seeks a model of TE that can support self-learning, peer-based learning and continuous learning. This requires a new perspective on in-service teacher education (INSET). Professional learning communities (PLC) of teachers have been seen as a

¹National Council of Teacher Education. 2010

approach to teacher education that can meet many of these aims. The paper attempts to abstract ideas and principles from the experiences of the Subject Teacher Forum program (STF), which is a ICT - integrated INSET program that has been implemented for Karnataka government high schools from 2011-2016 and in Telangana during 2015. The objective is to construct a model of technology integration in INSET can be in line with the processes of teacher development suggested by the NCFTE.

While discussing the implementation of the program, model elements have been abstracted and highlighted.

2 Subject Teacher Forum as a model of a PLC

The Subject Teacher Forum program, which was part of the in-service RMSA teacher education program, in Karnataka, attempted to build a PLC of high school teachers across the state.

2.1 Aims

The aim of the STF program was to reform INSET towards the vision of NCFTE, allowing for decentralised learning, teacher-directed, peer learning based TE and where the experiences of the teachers were sought to be brought in for enriching understanding of all. The STF program had the following key aims:

1. Learning to form communities of learning, using ICT (connecting to learn)
2. Learning to use educational and generic software applications for creating learning resources (creating to learn)

Learning to use educational and generic software applications for TPD and for teaching-learning (ICT for teaching-learning)

The decision was to establish the PLCs as state wide virtual communities, which would be interact through mailing-lists. The incremental component to the PLC model was the virtual mailing list which allowed teachers to share experiences and converse in a large and spread-out government school system. In the case of Karnataka, ITfC has so far trained around 1,500 'master trainers', who have in turn trained around 18,000 Mathematics, Science, Social Science, English and Kannada teachers from the 4,500 government high schools. Teachers have used technology for accessing and creating resources, using web tools and educational applications. Teachers have exchanged resources and experiences on the mailing lists and on several mobile phone based learning communities, most deal with academic issues and resources. The academic resources from over 100,000 emails shared in the forums, have been published on the [Karnataka Open Educational](#)

[Resources](#) (KOER); a web portal. KOER contains 7,000+ web page resources and 4,000+ files. The STF is an approach to training, hence the program can incorporate different content elements across years.

3 Designing and implementing the STF

3.1 Planning

The program was a part of the INSET planning of the education department. It was not possible to have all teachers in the state be part of the program every year, since the capacities for designing and conducting this program could only evolve over time. Hence, a perspective plan was prepared, phasing program across years, such phasing was based on – geography (select districts) and by subject (select subjects). Each state will need to customise the phasing based on contextual factors including number of schools, teachers, districts, state of ICT Infrastructure, current awareness to ICT etc. the table below suggests the phasing based on subject only (this may be sufficient for a small or medium sized state like Telangana, while large states will need to phase subject across different districts in different years).

Mathematics teachers, from our experience, tended to be the most 'technology-savvy' of all subject teachers and also tends to be an challenging area, requiring attention, hence the Karnataka program began with Mathematics, Science and Social Science subjects, and continued with languages.

Based on this, annual plans were designed by the state team. The phasing of subjects and districts will need to be decided by each state based on its local contexts and priorities. Secondly, the actual experiences of each year will inform the plans for subsequent years.

1. Model element – Preparation of a perspective plan (3-5 years) for STF. Preparation of Annual plans every year.

The department used the existing teacher education institutions to establish program management structures at the state (SCERT) and district (DIET) levels, in each institution, one or more officials were tasked to administer the program.

From a model point of view, the program management structures will need to have three components – academic coordination team; this will usually be the officials responsible for INSET at the state and district academic institutions (SCERT and DIETs), this is necessary for program implementation. The state level academic support team is the '**State Resource Group**' (SRG) or the **core team** that will plan and facilitate the program. This group will serve as the steering group for guiding the ICT implementation. The steering group will oversee the set-up of the infrastructure,

teacher training as well as curriculum and syllabus aspects. The steering group can have different sub-groups for review of syllabus and curricular resource materials, designing and development of teacher training programmes as well as infrastructure maintenance and support. The steering group could include members from SCERT, CIET, partner organisations implementing the ICT programmes as well as from academic and teacher training institutions.

A second component would be the **Technology support team** at the state and district levels, this will need to be created from the teachers, who are interested in developing technology skills and are trained on technology maintenance and support. The second component was part of the Assam STF, where teachers are much less exposed to ICT, but not in Karnataka and Telangana, where most teachers have had some exposure to ICTs. This component will be very useful to sustain ICT use, specially where the uptake of ICT is poor.

The third component will be the subject teacher forum **district resource groups**, these can be formed from the Master Resource Persons for each subject. The responsibility of this team is to provide techno-pedagogical support to the other teachers in the district. Formally, the third component has not been established in Karnataka, though this would be extremely useful to sustain ICT use by the teachers, informally the MRPs have played the role in some districts.

2. Model element – Establishing state and district level teams for co-designing and implementing the program.

3.2 ICT infrastructure

Since the program aims to enable teachers to learn to use ICT for connecting, ICT lab infrastructure is essential at state and district levels, preferably these should be established in the teacher education institutions (SCERT and DIET/CTE) if not already available. Although, the program can be conducted in the ICT labs available in engineering colleges, having the lab in-house will mean much easier (and cheaper) access. In-house infrastructure will also permit the institution to conduct training almost throughout the year, whereas external institutions are constrained by their own requirements and hence can make their labs available only at certain times of the year. Of course these labs can provide supplementing ICT infrastructure. Such labs can be set up using the TE funds for infrastructure development, ICT Labs are to be seen as core academic infrastructure, which any TE institution must necessarily have

In addition, schools will need to be equipped with ICT Lab, this can be done in a phased manner, using central and state government funds. All labs must have internet connectivity, either through a state-wide arrangement with a provider, or allowing school HMs to contract locally. In addition, teachers must be given interest free loans to purchase a computer / laptop and projector as their

personal assets, this will help them to continue using ICTs other than in their school labs. Currently interest free loans are already available to teachers for different purposes, and this needs to be extended to cover digital devices.

3. Model element – Establishing state and district level ICT Labs for conducting the program. Enabling teachers to acquire personal digital devices to increase the ICT device availability

3.3 Program design

The curriculum of the program focused on the learning of digital methods for fulfilling the three aims:

1. Connecting to learn (digital communication methods)
2. Creating to learn (digital tools to make materials including lessons)
3. ICTs for teaching-learning (digital tools for transaction)

In the workshop, teachers learn to use email (and phone based groups) to communicate with one another. Teachers also become members of their subject mailing-lists where they can communicate with all members at once. Teachers also learn subject-based software applications and generic resource creation tools (text image, audio, video editors) to create materials, and also use these applications for teaching.

In the STF program, the teachers came for a second round of training after a couple of years. In the second round, formal OER creation using these tools was focused on. Since the STF is a generic program, focusing on learning ICTs for TPD, it can incorporate any formal content. For instance, a topic like CCE or Adolescent education could be chosen and the methodology of accessing the web for available resources, creating text-audio-video-semantic map resources in a collaborative manner by participating teachers can help in building understanding of the topic, and support teachers peer learning, during the workshop and also subsequently in the mailing-list conversations. As more teachers become members of the mailing-lists, the program team organising the training, can share indicate program notes, containing aims, scope, contents and methodology of the program on the mailing-lists and invite comments from teachers, and use these to further refine the program design.

Over time, as teachers become comfortable learning using digital methods, the department can formally launch formal courses through blended learning approaches. This gradual approach to on-line education is more likely to succeed than simply launching MOOCs without adequate preparation of teachers in understanding and using ICTs.

4. Model element – Designing the program, in terms of workshop agenda and post workshop learning.

3.3.1 Free and open technology environment

The conference brochure puzzles why FOSS has not become popular with teachers. This can be addressed by teaching teachers to use FOSS education applications on scale (across the state) and providing basic technological support to teachers virtually and through district level support groups. Given the enormous benefits of FOSS, this approach will work. Teachers in Karnataka articulated the benefits from FOSS to include the following

1. GNU/Linux FOSS operating system is relatively virus-free. Not only this avoids periodic subscription to anti-virus software, it also avoids loss of data due to virus attacks and need to re-install software and the operating system
2. One time installation of the operating system includes installation of all the educational and generic software applications required by teachers, this is not possible in proprietary environment, where each software has to be separately installed.
3. Of course, FOSS is free to download and share, so it has no financial implications. Upgrades are also free to download and share. This is essential to ensure teachers upgrade regularly. In case of proprietary software, when upgrades are priced, the labs continue using obsolete versions of the software. Even now thousands of computers use Windows XP which is obsolete and vulnerable.
4. The use of FOSS reduces dependence on software vendors and avoids vendor lock-ins, which can be detrimental to the continued use of ICT in schools.
5. The use of appropriate generic and subject specific FOSS applications can help teachers create OER in many formats, to create a resource rich learning environment. Existing OER can also be modified towards this.
6. Most importantly, teachers can make the pedagogical connection between free education and free software. Just as a government funded public education system is necessary for universal education, free software is required for universal access to, and participation in the digital world. This creates a positive pedagogic environment of our schools, our software, for ICT adoption.

5. Model element – Chose free and open source software applications for the program. Create a custom distribution of the FOSS operating system (GNU/Linux) for free sharing amongst schools and teachers.

3.4 Design of training materials

NCERT has released ICT curriculum in 2013 and teacher training resources are available, which are aligned to this curriculum. The state academic team which is implementing the program will need to customise these available materials to prepare the training resources for the STF program. The

training program will have elements covering the learning software applications for accessing, creating and sharing resources and for teaching learning.

Given the structure of the school system, to include teachers across the state in the PLC, the cascade model of train the trainer will be adopted. However, using ICT to mitigate some limitations of the traditional cascade model, this can be called the blended cascade model. From each district, a group of suitable teachers can be chosen to be the Master Resource Persons who will be part of the initial workshops, and then conduct workshops for their colleagues at the district level. The initial training of the MRPs will need to be done by teachers or teacher educators or IT for Change team who have been part of the STF in Karnataka.

These workshops will involve cohorts of teachers teaching the same subject, to enable discussions on concepts and resources related to teaching that subject. In addition, there will be training of teachers on installing, configuring and maintaining hardware, software and rest of the ICT Lab infrastructure, these can help create small Technology Support teams in each district and at the state level.

All participants will become members of the mailing-lists and learn to use software applications for connecting and learning, for sharing ideas, experiences and seeking help. The participants therefore will continue to interact with one another after the workshops, through the mailing-lists and these interactions will continue between the district and state levels, for continued support and learning. Since the MRPs will continue to learn from one another and from their faculty and also be in touch with the teachers they train in the district workshops, this can be called a blended cascade, where elements of virtual learning are combined with the cascade workshops, to maintain continuity of learning and support.

Participants will also learn to use digital methods to create resources. The training resources (digital format) will be provided through a website, to encourage participants to refer to them on-line, physical copies should not be provided. Participants will have internet access throughout the workshop, hence can download the resources to their own computers (or pen drives). All participants will also get a copy of the software applications covered in the workshop and they will learn how to install the same on their own computers and school computers.

Creation of a web-space for resource sharing, both the training materials prepared by the core team and the resources created by the teachers during and after the training. It is better to create a semi-official web space using a platform like wordpress or blogspot, since the education departments website will not usually permit frequent updates. It will be easy to share any resource by mailing a hyperlink to other teachers.

6. Model element – Designing the training program – agenda, schedule. Conducting the state level and district level workshops. Creation of a web-space for resource sharing

3.5 Continued learning

After being part of the training workshops, teachers may try some of the lessons they have learnt in the workshops, and share their experiences on the mailing-lists. They will create digital resources by using the applications and share resources. They will seek help when they face problems. Other members of the mailing-lists can provide academic, technological support, creating a self-sufficient learning community. Assignments for resource creation could be identified during the workshops and be completed and shared over the mailing-lists. Specific discussions on identified topics could also be carried out in the mailing-list, on topics of interest to the teachers, concerning their subjects and also larger issues in education.

Teacher educators and experienced teachers and college faculty can also be added to these mailing-lists to mentor and curate the discussions on these forums, to facilitate teachers self-directed learning and peer-learning. During the discussions on the lists, it is likely that some teachers (who may not be from the known MRPs) will take lot of initiative to support their colleagues. Thus providing a state-wide canvas can enable natural leaders to emerge, who put in effort to share their learnings and experiences with their colleagues and also respond to their support requests.

If required, the district teams can visit the school of any teacher to provide site-based academic and technological support, if the virtual support provided is not adequate. The teacher-education institutions can also use the PLC as a forum to discuss issues of educational and social concern and also to get inputs.

7. Model element – PLC as a forum of continuous, decentralized, self-directed and peer learning based TPD.

3.6 Open Educational Resources

From the larger pool of resource persons, a smaller group of and ICT capable teachers was trained in processes of OER creation, review and publishing processes in Karnataka and Telangana. These teachers developed OER for the different topics in the school syllabus, in district teams. In Karnataka, these resources were uploaded on the KOER web portal, created using the MediaWiki software. In Telangana, a similar process is planned. In Karnataka, the STF teachers are creating OER and sharing on the mailing-lists. Some of these resources, perceived to be useful, are being uploaded on the KOER Portal by the IT for Change team.

Along with the OER creation, a **resource review core group** needs to be formed which will develop processes and benchmarks for review of teacher created materials and resources created

during the teacher training workshops; this will provide a continuous, sustained model for development and publishing of resources. This role could also be played by the state core team. With support of the academic advisory group constituted within the SCERT, the resource creation group can review resources shared in the various subject teacher forums and share them for publishing to a web based repository. The publishing on the web repository will need to be done by a **resource editing and upload team**, which will need to be established. The development of OER by the teachers, formal review by the review group and uploading by the editing team can create a sustainable model for OER development in local languages, in the public education system. The district academic support teams can be formally assigned subjects/classes/topics for OER development, which they can co-ordinate with their colleagues in the district.

Over time, this can cover all topics from all subjects, all grades, and in all languages forming a medium of instruction in the state.

8. Model element – OER development as a key activity of the PLC. OER development and sharing provides the PLC an important rationale for its existence. OER becomes an important output (local and contextual learning resources) of the PLC.

4 Expected outcomes

The primary outcome is to help the teacher-education become need based, participatory, continuous, peer-learning based/mentored etc. as envisaged by the NCF TE 2010 This is expected to impact quality of school education. A second outcome would be the creation of contextual digital learning resources in the local languages and sharing on the forums. A third outcome could be the larger collaboration amongst teachers and teacher-educators from different institutions, in different locations, at different levels, in all areas. The program will create large networks of peer learning, which can help strengthen the content and processes of school education.

The program principles need to permeate the regular teacher-education programs, and bring in elements of blended educational, combining in meaningful ways, physical and virtual learning. The experience gained from implementing this program, can thus support the revision to the basic TE model itself in the state. Hence STF is not to be seen as an 'ICT' program but as the mainstay in-service TE program.

4.1 Institutionalizing the program

The SRG should conduct regular training for the department officers (from both academic and administrative institutions). This has been successful in Karnataka and has created a much larger understanding and support for technology integration. This can be done in the state ICT labs. In Karnataka, DIET faculty were oriented to the STF through a teacher educator education program,

and this helped many of the get involved in the training in their DIETs in a substantive manner, apart from providing programmatic oversight.

The curriculum and syllabus of the secondary education should incorporate the digital methods and resources, through the SCERT. In Karnataka, the revised DeEd. Program has a paper ICT Mediation for teaching, which incorporates elements of the STF program. It has two units in the first year of the program (ICT for connecting and learning (self learning and peer learning) and ICT for creating (generic resources) and learning) and two in the second year (ICT for creating (subject specific resources) and learning and ICT for subject teaching-learning). Kerala has incorporated these elements into the regular subject text books in high schools and into the ICT subject also.

The upkeep of the ICT labs will require regular maintenance of, as well as additions and replacement to the infrastructure. ICT infrastructure tends to be fragile and has a short life-span unlike traditional school assets like classrooms or blackboards. Regular renewal is necessary to keep the labs up continuously.

9. Model element – Institutionalizing the program will require the building of teacher educator capacities in integrating ICT for professional development and in teacher education. It will also require incorporating elements into the curriculum and syllabus of teacher education and school education. ICT lab maintenance, renewal and additions should be a regular planned effort.

4.2 Sustainability

Sustainability is a function of value perception. If teachers find that ICTs can help them develop professionally and provide support to their teaching, their use of ICTs would sustain. Our experience in integration of ICT in education suggest that ICT interventions are sustainable when:

1. Curriculum of the program largely pertains to the regular subjects of the school (and is not limited to learning few software applications)
2. Teachers of the school have a key role to play in the curricular transaction (and not outsourced vendor faculty)
3. A large number of free software applications and content are used to create a resource rich environment, instead of having a limited proprietary environment.
4. Teachers and students use software educational tools to create resources, instead of only consuming pre-prepared resources.
5. Teachers use virtual networks for peer-learning and sharing for continuous professional development

The design of the STF program is to enable the department to sustain it over time. The funding for the program is from the regular RMSA INSET funds and from the RMSA ICT training funds. The creation and maintenance of ICT infrastructure will need to be done through state funds or [ICT@Schools](#) scheme of RMSA. The program is implemented by teacher education institutions at state and district levels.

The systemic nature of the program, can enable scalability, to cover all subjects in a phased manner across entire state. It allows for sustainability, since RMSA INSET funding is expected to be available over the next decade. The virtual networks (mailing-lists) are free to maintain, and mentoring of the discussions on these lists can be undertaken by teacher educators as a part of their assigned responsibilities.

10. Model element – Scalability and sustainability through the systemic nature of the program

5 Insights

1. Having a large number of teachers in the PLC is an advantage, even if a small percentage of teachers are active, creating and sharing OER, seeking help and responding to support requests, it creates a meaningful traffic on the lists and benefits even those who are passively participating (lurking).
2. Having an explicit objective like OER creation for the PLC, provides a useful objective for the community interactions. This is also an objective that teachers can easily understand as many of them are usually in the look-out for materials. The actions of a small percentage of teachers can also result in the creation of a significant quantity of OER, which will be in English as well as the state languages.
3. More advanced aspects like discussions on pedagogical aspects, assessment, macro educational and social issues will gradually enter as the community participation matures and members hone their discussion skills. It can also be seeded by teacher educators in a planned manner.
4. Mediawiki, the platform used by Wikipedia, supports collaborative OER creation, by allowing easy addition and modification of content. It supports the embedding of all resource formats. It is ideal CMS to host OER created by teachers. Teachers may achieve comfort in editing on the MediaWiki only over time.
5. Developing a comfort in using ICT enables teachers to create OER and also share OER with their peers, as well as seek information and resources from the internet and from peers, this can support teacher agency and professional development.

6 Model variations

The model discussed in this paper will need to be customised based on the local contexts and priorities. In Karnataka, the PLC was established first and then the OER development processes initiated after 2 years, while in Telangana, the program began with a small set of teachers creating OER, which was intended to be used during the PLC creation to support their learning. Andhra Pradesh too began with the OER development and publishing on the platform before commencing the PLC creation. Perhaps there is a diffidence about conducting a cascade training across the entire state, which is a distributed effort, this encourages the creation of OER at the state headquarters. However, the existence of a strong PLC can support OER creation and sharing, since it will be taken up by many more teachers across the state.

7 Challenges

In the PLC model there are several challenges, both familiar and new, that need to be addressed. The first is the easy availability of ICT infrastructure. Though, by increasing the value perception of ICTs to teachers, they are encouraged to acquire personal digital devices and motivated to maintain their school labs, it is still inadequate. Secondly, the provision of ICT infrastructure to schools has to be accompanied by workable methods for maintenance and renewal. Internet connectivity and electricity supply also remain as serious challenges, though the intensity of the former will reduce over time.

There has to be a formal facilitation of the PLCs to encourage the silent participants also to share their experiences, ideas and resources, this has been done in a very limited and informal manner in Karnataka, which has been inadequate. Similarly, there needs to be formal structures to academically assess the OER created and shared by teachers and provide feedback to the creators, this itself can be a powerful TPD for all teachers. Resources approved by these groups can then be made available on the OER portal. This will help improve both the process and outputs of the OER creation in the PLC.

8 Sample – Perspective plan

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| Year 1 | <ol style="list-style-type: none">1. ICT syllabus and content development / contextualising from the NCERT ICT curriculum (this will be a continuous activity, developing the student text books and teacher hand books across the grades, and can be completed over two years)2. Maths and Science District Forums to be formed for teachers to be initiated into technology for self-learning, peer learning and for learning to use technology for digital classrooms; this will include training on ICT syllabus for students3. State and district ICT infrastructure4. Technology Support teams at state and district levels5. State Steering groups and sub-groups for programme implementation |
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| Year 2 | 6. ICT syllabus and content development / contextualising from the NCERT ICT curriculum (completing the development of student text books and teacher hand books across all grades) 7. English and Social Science District Forums to be formed for teachers to be initiated into technology for self-learning, peer learning and for learning to use technology for digital classrooms; this will include training on ICT syllabus for students 8. Maths and Science OER 9. State and district infrastructure (including distribution of school server, etc) 10. Rolling out ICT programme for students in schools (can be in select districts) |
| Year 3 | 11. State Language and Head Teacher District Forums to be formed for teachers to be initiated into technology for self-learning, peer learning and for learning to use technology for digital classrooms 12. English and Social Science OER development 13. Strengthening the school level ICT integration through appropriate textbook revisions 14. State and district groups to take larger role and ownership of designing and implementing the programme |
| Year 4 | 15. Deepening the training for mathematics and science; evolving blended courses for teacher development for continuing TPD 16. Formation of district forums for other languages 17. OER for languages |
| Year 5 | 18. Deepening the training for Social Science and languages; evolving blended courses for teacher development 19. Extending the Subject Teacher Forum for other subjects, as per state's priority |

9 References

- Analytical_Report, Karnataka Education Department, Retrieved from http://www.schooleducation.kar.nic.in/databank/201112_Analytical_Report.pdf
- 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
- ICT Schools evaluation, 2015. by Central Institute of Education Technology, NCERT. Retrieved from <http://www.slideshare.net/GurumurthyKasinathan/ictschools-evaluation-by-ciet-ncert-karnataka2015>
- 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 I T 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

- 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>
- 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
- Public Report on Basic Education (PROBE) report. 1998. UNDP. Retrieved from www.undp.org/content/dam/india/docs/public_report_basic_education_india.pdf
- Right of Children to Free and Compulsory Education Act, 2009. Retrieved from http://librarykvpattom.files.wordpress.com/2010/04/india_education_act_2009.pdf
- 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)