

# M-Learning: Mobile - enabled Educational Technology

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## **Abstract:**

The proposed paper will exemplify the dynamics of M-learning and its pedagogical implications within the Indian rural education ecology. This study seeks to benefit various stakeholders in the education, telecom, rural industry and policy making sectors by providing meaningful insight into the macro and micro challenges and proposing innovative application, service and system solutions to address the same.

**Keywords:** M-learning, applied innovation, future mobile applications, education, knowledge, literacy, connectivity, rural development, VAS

India faces profound hard infrastructural challenges especially in its villages. Education has been acknowledged as one of them.

About 35% of world's illiterate population is Indian. Despite seemingly optimistic Gross Enrollment Ratios (GER1) being recorded and proactive literacy schemes (SSA2, NLM3 and Mid-day Meal Scheme) being introduced, there is a disparity between these positive indicators and actuality. A high dropout rate of 41.2% is seen at the elementary level. The national literacy rate of girls over seven years is 54% against 75% for boys. In the Northern Hindi-speaking states of India, girls' literacy rates are particularly low, ranging between 33 – 50%. Quality of instruction and learning is low. Students' understanding and application of written and verbal expression, logic and reasoning, numeric and quantitative knowledge is inadequate.

Geographical remoteness and access challenges, regional, gender and socio-economic inequity, poor infrastructure, amenities and non-conducive learning environments, academically inclined content (often in contrast to practical applicability), corporal punishment, apathetic and untrained teachers and theoretical pedagogy, are key causative factors for poor accomplishments in the education sector.

Education in the current scenario should be seen as a semi-hard infrastructure challenge. Of all infrastructure concerns that India faces, education is one that can be rapidly addressed through strong soft infrastructure networks. Compared to highly tangible services like healthcare, finance, electricity, transportation, governance which can be only partially and gradually addressed through soft-infrastructure, education holds a definite advantage.

This is due to the sheer nature of knowledge, by the virtue of it being intellectual and intangible property it can be disseminated through most communication mediums, including mobiles. We have instinctively always looked at education as institutional infrastructure dependant, but looking at it independently opens up diverse platform possibilities, more so now, when societies are increasingly becoming technology trusting and receptive.

An evolution of wireless technology platforms, from addressing community needs to

attending personalized needs, has been seen over the last decade. ITC e-choupals, Intel village Kiosks and Nokia Siemens Village connection; information initiatives for community access, have progressed into individual tailored usage services such as Nokia Life Tools. Consumers seek need and skill based customized knowledge and therefore the shift in platform preferences.

Mobiles hold various advantages as the preferred media for education, they are multi dimensional levelers. They flatten socio-economic hierarchies; counteract competency insecurities, cut across geographies and require minimal hard infrastructure. What makes them the sought after technology for the education sector is also that they are a deep embedded medium of communication in India today, due to increasing tele-density. They are a personalized and non-infrastructure dependant medium, not disrupted much by natural and social calamities; therefore consistent and sustainable. Key characteristics of the media like audio and voice, still and interactive graphics and numerics work naturally well to build accurate phonetics and oral expression, number intelligence, associative, cognitive and logical ability, overall comprehension and application skills. Learning has mostly never been tailored to user needs. Individualized instruction can be easily achieved through mobiles thereby overcoming challenges posed by varied degrees of learner competencies. Since mobiles respect privacy and are nonjudgmental they have the potential to provide skill / need based learning, focused attention on specific areas, extra mentoring and counseling. In case of varying degrees of learning abilities, slow learners can subscribe to elaborate lesson explanations; this cultivates interest in learning, builds confidence and empowers the student.

Mobile - led pedagogy can effectively foster autonomous learning among students. Research establishes that interactive and participatory approaches, lead to practically relevant learning, holistic aptitude building and functional skill set development, thereby furthering valuable application of knowledge.

New service initiatives in Interactive-learning have been made. Nokia Life Tools launched English vocabulary building and test preparation offerings. While this service has overcome comprehension issues, it does not address the holistic tele-learning challenge; services are not adequately contextualized; only mobile-literate people can effectively use services, illiteracy remains unaddressed and scope of the service" value is relatively less within the large rural education ecology. Educomp introduced interactive technologies for classroom teaching. These solutions work well for urban schooling scenarios, but the same cannot be said for rural and peri-urban scenarios; technologically advanced teaching aids that are not immediately scalable, hard infrastructure requirements and technology literate teachers; such pre-conditions make this proposition unrealistic in rural ecologies. IGNOU will also launch vocational training modules through mobiles, though the effectiveness of this service is yet to be seen. While a start has been made, proactive, effective and robust service innovations are yet to materialize within the existing technology.

The true mettle of any technology is realized when it is put under a versatility test. The crux of the issue is exploring and realizing the full possible potential of mobile media technology. Consequently mobiles could be the next education media platform. This can be achieved through development and introduction of innovative and contextualized services that broaden the functional limits of the media.

The proposed paper will present services for M-learning in urban and rural contexts, empowering various stakeholders in the education ecology.

- Educating students, informing and educating parents about literacy and training teachers.
- Enabling self skill building and income generation abilities through „Learn while you

earn" services for professionals.

- Contextualizing learning services for disabled.

The proposed paper will explore, in detail, various new and contextualized service innovations and applications and their potential. Some of these are listed below.

- Do-it-yourself literacy and knowledge kits with handsets, instruction guidelines, subject packages and knowledge subscriptions, in a holistic permutation of video, audio and textual applications.
- Creation of wireless communities and virtual / real study groups within existing rural education initiatives.
- Transferable knowledge credit and recharges, M-knowledge vouchers, subject credits, and credit earning scholarships.
- Interactive educational video games, logical reasoning and problem solving aptitude games.
- Public forum competitive challenges such as subject Olympiads and spelling bees. Disability assistive technologies such as Braille lettered screen / pad phones, audio to text and text to audio applications.
- Preparatory audio recaps and archived lessons. Subject email and SMS subscriptions.
- Subject specific Tele-meets and Live Q & A sessions. Out of the classroom assessment plans.
- MMS live classroom sessions and web and podcasting. Transferable note images.
- Phonetic guides (audio and visual)
- Form sensitive touch-screens for alphabet formation; screens as corrective slates. Virtual scenario building to assess practical application of knowledge.
- Co created knowledge database for teachers and query search service.
- Practical training for „teaching through mobile mediums" for educationists.
- Media multitasking burgeoning and becoming a strong social trend, urban education capitalizes on it, by devising education networks.
- Mobile whiteboards for interactive discussions.

## **1.0 Educational Context in India**

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India is an emerging economy whose core strength for the next 25 years is expected to be its youth. The youth (aged below 25 years of age) constitute 41.05% of the overall population. While this 'Demographic Dividend' can yield enormous benefit, it also comes with considerable challenges around the need to prepare the youth with basic education and

employment in order to provide youngsters with the skills that can help them lead productive lives rather than degenerate into lawlessness, illegal activities and terrorism which the subcontinent is already groping with.

The challenge in front of India today is that of providing the fundamental right to education to its next generation. About 35% of world's illiterate population is Indian. Despite seemingly optimistic Gross Enrollment Ratios (GER1) being recorded and proactive literacy schemes (SSA2, NLM3 and Mid-day Meal Scheme) being introduced, there is a disparity between these positive indicators and actuality. A high dropout rate of 41.2% is seen at the elementary level. The national literacy rate of girls over seven years is 54% against 75% for boys. In the Northern Hindi-speaking states of India, girls' literacy rates are particularly low, ranging between 33 – 50%. Quality of instruction and learning is low. Students' understanding and application of written and verbal expression, logic and reasoning, numeric and quantitative knowledge is inadequate.

Geographical remoteness and access challenges, regional, gender and socio-economic inequity, poor infrastructure, amenities and non-conducive learning environments, academically inclined content (often in contrast to practical applicability), corporal punishment, apathetic and untrained teachers and theoretical pedagogy, are key causative factors for poor accomplishments in the education sector.

## **2.0 Current Educational Initiatives and their Impact**

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The nature of educational content available in India today is highly diverse. The urban youth has been the prime focus of interactive educational content ranging from educational lessons to game series on DVDs to e-learning methodologies in classrooms like Educomp's Smart Class to interactive programs on Tata Sky. The rural youth on the other hand, can be seen to have access to computers at best and facing a shortage of even a basic instructor at the worst. Such a wide gulf in resource distribution and access, coupled with the considerable price tag of interactive educational services, make existing content and systems unviable for the cause of universal education.

Consequently, the areas of change that have been possible in national education has to do more with the nature of teaching methodology and content type than content representation, interactivity and access. There has been a shift from a Behaviouralist approach to teaching to a more Communicative one and more Indian writings by the likes of Sarojini Naidu, Vikram Seth and Sudha Murthy, have been included to integrate Indian sensibilities in text in order to facilitate comprehension in students. These aspects, however, have very little to do with making the content accessible to all in an interesting and comprehensive manner.

National education, especially at the primary and secondary levels, has also failed to adapt the benefits of diverse technologies that are available today for the cause of education. An evolution of wireless technology platforms and mobile enabled solutions, from addressing community needs to attending personalized needs, has been seen over the last decade. ITC e-choupals, Intel village Kiosks and Nokia Siemens Village connection; information initiatives for community access, have now all progressed into individual tailored usage services such as Nokia Life Tools but the mechanisms of none of these services can be said to have been exploited as richly as they can be for the purpose of making education accessible.

## **3.0 Innovating for the Educational Segment**

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It is in this context of a surplus amount of technical capacities being existent that can be

deputed to the purpose of education, that this paper on M-learning now proposes to explore various interactive ways in which innovative educational tools and methods can be made accessible to the masses at effective value points.

### **3.1 Self Learning**

Students' comprehension and application of subjects when taught well initially, is mostly a self-regulatory process. There is evidence that self teaching and learning abilities in lower age groups are very high. The natural inquisitiveness and curiosity of today's youngsters can work to the advantage of M-learning. Tapping into natural propensities for knowledge acquisition, major parts of the learning process can be effectively self directed by student groups themselves with light teaching and the provision of the requisite material for self practise.

To enable such self learning, our first proposed solution is 'Do-it-yourself Knowledge and literacy packages. These self learning kits can be customized for diverse grades of learning – from basic primary education to middle and high schooling and for self skill building purposes as well for the 'self scaling sector,' that is, lower than class ten pass but with positive motivation around adult learning. Such a kit would ideally constitute of a usage instruction guideline, knowledge subscriptions and subject packages, all of which can be delivered on mobile.

A visually intensive diagrammatic guide for package induction, handset usage and application introduction and navigation can facilitate clear communication and independent usage of the kit. These guides can be parent assistive when learners are too young. A visual index with the service will provide a guide for ease of use navigation and understanding. An audio visual induction of the subject will be done for the student around the stipulated syllabus. Subject content will be disseminated through dynamic applications which will be in holistic permutations of video, audio and text.

As discussed earlier in the abstract, natural characteristics of mobile media such as audio and voice, still and interactive visual graphics and numeric's work well to build accurate phone tics and oral expression, number intelligence, associative, cognitive and logical ability, overall comprehension and application skills. The potential of these features has hardly been exploited adequately for the purpose of education.

This proposed self-learning kit utilizes these basic features of most mobile phones today to build customized applications for educational technology.

Audio books and lessons will be introduced and chapter-wise transmission will be conducted. Rhymes, jingles and poems will form a part of the syllabus. Audio dictionaries, thesaurus and grammar correction applications will facilitate a stronger grasp over the language. Audio visual phonetic narrative applications will help build verbal articulation. An audio record, speech recognition and playback corrective mechanism can be easily used as a testing application for improving reading and pronunciation. Students will read with much less hesitancy and more enthusiasm. With an error tolerant and non-judgmental application or device as a listener there will be no intimidating figure of authority; parent or teacher pointing out every slip-up. This would encourage self practice, fluency and confidence.

Numbers and calculations will be shown with corresponding visual representation for better associative understanding. Audio calculators can help in building speed and accuracy in calculation abilities. Speed math and number puzzles, teasers will help build basics that are strong and context independent so that application of theories can be universally relevant. Math concepts such as algebra to logic, applied math to number theory, statistics to geometry can be taught well in a stepwise progression and with visual accuracy and

animation that are achievable even in a simple mobile media.

Case studies, virtual scenario building and story-telling, demonstrations and virtual 3D simulations of content will help in modeling information for effective learning in most subjects. Chapter-wise transmissions in presentation and audio formats can also be done easily. Live classroom sessions can be sent through MMS. Image transmission of notes can be done which can be archived for later use by students.

M-book references, participations in interactive bulletin boards and discussion groups, quick facts and tips and FAQs will also be component parts of this knowledge subscription. Each subject along with subject packages will have on offer, educational gaming applications for learning and testing. Interactive maps for geography puzzles, highlighting topography and profiling landscapes are interesting propositions to learn applicable geography. Visually intensive historical timelines, people, places and events would make retention in history, particularly, high. Dynamic graphs and speed math games, logical reasoning and problem solving aptitude brainteasers can help in building associative, cognitive and logical ability, overall comprehension and application skills. Textual and audio para building, visual word jumbles and riddles would help build communicative linguistics.

Multi sensory stimulus, as in this case, will ensure focused attention for longer time periods, high retention and holistic engagement of the mind.

### **3.2 Customized Knowledge**

Knowledge is most likely to be retained and applied when it is student-tailored. The fact that mobile content can be dynamically modified and updated quickly, also helps in countering challenges posed by obsolete and theoretical content. The ability to customize learning to the needs of each student has almost always been an impossible challenge for any universal education delivery mechanism. Such a solution, however, can actually be possible today due to the possibilities offered by mobile ownership.

The most convenient way through which M-learning can facilitate customized knowledge is by the simple playback mechanism that can be found in all handsets in the market today. Subject content is accessible at all times and can be repeatedly reviewed for better comprehension and understanding. Revisions can be self-paced. Mobile mentors can send preparatory audio recaps of lessons before exams. Archived audio lessons are accessible on phone. Timed subject specific tele-meets, Live Q and A and FAQ sessions can be held to clarify doubts and practice effectively. Mobile interactive bulletin boards can help in these sessions, where dynamic note taking and summarizing is done and archived. These formats of robust preparations and continuous guidance ensure that subject knowledge is thorough and therefore applicable.

Customized knowledge is also the most sought after post assessment where loopholes in learning emerge. This is a time when mobile mentoring can be made possible wherein, following testing; focused attention on specific areas and elaborate lesson explanations can be prescribed. Personalized coaching and rigorous tele-meet participation and frequent testing can be done. Challenges posed by different degrees of learning ability versus the inability of current standardized instruction formats to meet the needs of different learners can thus be overcome by such simple mechanisms of repeat exercises, practising and doubt clarifications.

### **3.3 Knowledge Testing**

The rationale of education is not limited to learning but also retention and realistic

application of knowledge. In order to achieve testing that is ongoing, immediate and resonant with the needs of the learner, one can propose out of classroom assessment formats.

Our first proposed Multiple Choice Question format of testing, is easy to achieve through existing SMS technologies. Ten or more questions can be asked in an extended number of smses and learners will only have to click on their answers before sending the questionnaire back to the centralized content server for review and correction. Specialized cost structures can be introduced for the extended smses.

Secondly, another proposed solution around testing can also be audio exams that are in viva formats. The viva could be either live tele - vivas that can be conducted on call or recorded submissions using the mobile recorder, the audio file from which can be shared using data transfer channels.

Thirdly, for more exhaustive written exams, answer sheets can be clicked through camera phones and images transferred for collective checking. Each community schools can have a stipulated ratio of inexpensive smart phones to students and outside community examiners can be brought in for fair invigilation. Timings for the exam can be self selected and tests can be time bound and held in local community schools without having to travel the distances to bigger city examination centres.

Such amalgamation of voice and image based formats have multiple advantages. Firstly, students develop fluency in communicative languages which is one of the biggest challenges for Indian learners today with their heavy theoretical focus. Secondly, knowledge across theoretical subjects is expressed orally requiring students to prepare more exhaustively since the exam tests their understandings more than memory. Lastly, since such testing can also be done through mobile applications, virtual scenarios can be narrated through audio. Students are provided with mini visual case studies and their comprehension of the subject and its fundamentals is assessed. This de- contextualizes their previous learning and assesses the learner on practical application of fundamentals within a wide variety of situations. Finally, such methods also reduce the stress of travel and infrastructure which students in India continue to face today when they have to sit for an exam outside their own community. Such testing mechanisms, thus not only enable vocal participation, expanding knowledge of the curriculum and reducing effects of learning by rote, but this also enables the learner by making available an infrastructure that is always there and for which they do not have to go additional stress above and beyond that of exam worries.

### **3.4 Mobile Libraries**

Successful education is dependent not merely on what is taught and how well is it taught but also on how what is taught enables the learner to seek additional information on their own. The interrogative abilities that lead to a researching interest have very little scope in the context of primary and secondary education in India. This is often, largely because of a gap in the curriculum which is then justified by infrastructural challenges of not having libraries. Our proposed solution to this scenario is that of M-Libraries. An M-Library is a system whereby all students can download content from online educational portals and store them on mobile or burn them in DVDs for future use.

The technical requirement for this is an average to low cost handset but which could progressively have greater memory capacity. The operating mechanism of the service will require an educational board to prepare a long list of additional reading and reference materials which they can make accessible to schools in a document. The school can distribute this to parents for them to consult with their children and order as and when required in the academic year. Going digital with the content, has several positives. Firstly,

parents do not have to make a high down payment on books which the children may or may not use through the year, resulting in wastage. Secondly, such books being low in size, can be stored more easily than proper books. Thirdly, being lower in the cost front, more M-books can be purchased than actual books.

The solution also has several clear benefits for authors. More authors can be enlisted and become accessible to students without challenges of lack of delivery mechanisms. Each author has the choice of whether to publish in hard format or not. Not only do they save on print and distribution costs, but by going digital, each author will also be able to reach out to an unprecedented number of students which current mechanisms cannot even make possible. Fears around peer sharing can also be allayed by integrating security mechanisms that prevent sharing through Bluetooth but sharing via content send should be allowed to increase revenue mechanisms.

### **3.5 Wireless Communities**

Media multi-tasking is a strong social trend; both urban and rural communities are increasingly becoming technology trusting and receptive. Education should capitalize on this fact and devise strong soft educational infrastructure networks. In the context of mobile enabled education, a proposed solution is the creation of wireless education communities. Firstly virtual and real study groups can be created; these can constitute same grade peers or senior and junior grade peers. Public forum competitive challenges through mobiles such as subject Olympiads, spelling bees and speed educational gaming can be conducted within these student networks and knowledge credits on performance evaluation. Same grade peers could dynamically work together as projects teams, hold team discussions and participate in tele-meets as well as exchange notes and study collectively. Senior grade peers can play partial mentors and teach junior grades through mobile mediums. This arrangement will have two expected outcomes; firstly this arrangement will compel seniors to look at the subject in deeply explorative ways. They will seek to gain a thorough understand of the subject to effectively teach it and therefore will add to their own detailed and comprehensive learning. Secondly, since a teacher like figure of authority is absent, the juniors" will be relatively uninhibited to ask questions and probe newer possibilities into the subject. This format could also be an effective way of testing senior students on their understanding of the subjects. Also since the teaching will happen through a mobile medium with, predefined content and applications scope of subjectivity will not be much.

Secondly, teachers teaching teachers wireless communities can also be created. Within these wireless communities educationists are provided with practical training and internships for teaching through mobile mediums. A district to block or an urban to rural knowledge transfer system can be created within these communities. One urban and one rural teacher will be in a peer or mentor and protégé roles; this arrangement will serve in counseling and assistive functions. Retired teachers could contribute in this arrangement as well; their knowledge and expertise gained over the years could be capitalized on by this format, without them having to travel and be physically present to teach. Teachers will build a centralized co-created knowledge database with a query search service accessible through mobiles. While this database will have syllabus content and archives, it will also be dynamically updated with urban and rural information that can be shared and brought together for the greater benefits of their respective students. Audio and Video Blogs will be uploaded, streaming of classroom live transmissions could also be done. This arrangement will

facilitate sharing of innovations in pedagogy and aids in educational technology. Teachers could also earn scholarships; self skill building and M-teaching training subscriptions and credits, on students performance evaluation.



### **3.6 Gifted Knowledge Recharges**

Transferrable knowledge M-vouchers, credits and subscriptions can be gifted or distributed. The content in these recharges facilitates flexible learning without restrictions in terms of timings and tests, unlike in the case of literacy kits. Transfer and distribution mechanisms of these can be very diverse. Community Schools could get a subject wise credits, which they could then distribute to eligible students in their purview, regardless of enrollment. Upper and Middle class can buy knowledge credit and pass it on to their domestic helps, vendors, drivers, low income group acquaintances to teach their children. For the self scaling segment, the community can fund knowledge credit for self skill building. Knowledge credits act as a advertisement for the self learning kit. They generate the initial interest and users are motivated to self learn in larger sense.

### **4.0 Solution Viability for Interested Stakeholders**

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The M-learning based solutions that have been discussed above are all dependent on existing and available mechanisms. They rely on entry level handsets worth 5000 INR and at the maximum can go upto a smart phone which market specialists" claim will be available within 8000 INR in less than 2 years. Aircel is already directing itself to such directions by launching a full QWERTY phone in 2999 INR in the last week. All these devices are expected to have basic audio recording and hearing facilities, video transmission abilities, GPS enablement and a Hindi - English or local language enabled key pad. Considering that the technical requirements from the devices that can support such M-learning content, are very basic and do not pose any challenge to uptake, in order to assess their viability further, we now have to further assess these solutions under two other heads- need for additional support infrastructure and costing.

The support infrastructure that these M-learning services require is no more than the basic voice and SMS and MMS channels. It is true that GPS enablement will be a major boost but the activities that one has delineated above can be equally attempted with the basic mobile networks. Within this existing mechanism, certain technical improvements stand to make the user experience of such content rich services better. For example, if the size of smses can be expanded from 140 characters to unlimited but can be charged as per 140 characters without breaking the message up, this will be a significant improvement. Similarly, the evolution of audio blogs, while it exists in recorded customer servicing functions, if expanded to generate real time directional and feedback mechanisms, can also make the community and problem solving services possible without any substantial rework.

Finally, from a value assessment, it is evident that as a nation, Indian parents are highly education oriented and motivated to provide their children with the best options available. Such aspirations, which can lead to consumption of educational content, may be the highest in the higher SECs like A to C but the need for it, is felt much more acutely in the lower SECs like D and E, since education is the only empowering factor that can help them rise above their current status.

Our initial field research with parents of SEC A to E indicate that educational content is actually one of those very few content areas for which there is an unanimous need. Given the challenging context of Value Added Services, where very few content types have managed to capture the attention of the national audience, education clearly emerges as a source of information which is most likely to be pulled by immediate and potential users than having to be pushed by operators. However, educational content comes with a noble perception association.

Parents feel that while M-learning solutions will be much sought after, it is their pricing

which will decide the extent of their outreach. Due to the nature of India's mobile penetration, parents foresee increased consumption. They, however, point out that since education is a noble service, all stakeholders in this domain will be expected to reduce premium pricing. The services also using soft infrastructures and doing away with hard printing and distribution mechanisms, should come within reasonable amounts. Bypassing challenges around acquisition, maintenance and distribution, M- learning concepts should enable the learner to decide what they want to study, how they want to study and how they want to use this knowledge. Encouraging the desire to learn on one's own, making learners more inquisitive, able in decisioning and a proud in success and undefeated in failure should be the aim of M-learning initiatives in order to help shape the nature of Indian education for tomorrow.

## **5.0 About the Research**

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Developing ecology for holistic education and to be able to give access to such education to all youngsters, irrespective of their socio-economic background or abilities and disabilities, is a vision statement for CKS. The organization internally funds small grant projects, conducted by its internal researchers as well as other external participants, to try and understand how better educational solutions can be generated for India, given its challenge with literacy. The current paper is an outcome of a research conducted around December 2009, on the topic of the value of education as a Value Added Service and ways in which to integrate new teaching tools into VAS offerings to encourage mobile based education overcoming challenges of pricing, access and remoteness.

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### **Definitions**

1 GER: Gross enrolment ratio is the percentage of the estimated child population in the age group 6 to 14 years enrolled in classes" I-VIII.

2 SSA: Sarva Shiksha Abhyan is a flagship programme of the Government of India for achievement of universalization of elementary education, making free and compulsory education to children of ages 6-14 a

fundamental right.

3 NLM: National Literacy Mission was set up by the government of India on 5 May 1988 with an aim to eradicate illiteracy in the country .It aims to make 80 million adults in the age group of 15 - 35 literate over an eighty year period.