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# Mobile Learning in India

## SCOPE, IMPACT AND IMPLICATIONS

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# 0. ABSTRACT

This paper presents a synthesis of the research in the field of mobile learning initiative and policies. It presents the case of India, which has immense potential due to its increasing mobile market size and internet user base.

The paper begins with discussing how mobile learning can aid in learning, its strengths and current challenges. It then progresses to analyse the current policy catering to mobile learning in the Indian education system. The focus of Indian education system has been to build basic infrastructure and provide basic literacy for all. Although the policy wisely includes technology for improving quality of education, there is no specific mention of mobile learning and its implication in the policy. The paper then moves to providing suggestions by summarising previous work done and calls for a technological infrastructure setup for initiating mobile learning projects. The recommendations stress for a stronger collaboration among all stakeholders (policy makers, research institutions, private organizations, schools and states) for co-evolution of each stakeholder informed by research and ground realities. This will result in the implementation of effective and scalable mobile learning projects and help in realizing the full potential of such technologies for education.

# 1. INTRODUCTION

"If we teach today's students as we taught yesterday's, we rob them of tomorrow."
– John Dewey

Learning is a broad term that happens both lifelong and life-wide. Education is considered a subset of learning that can drive growth, economic prosperity and advancement of an individual, a community and a country. Learning doesn't need an institution and can happen informally. Education often happens in an institutionalised manner in a more formalized way. Yet, in the kind of education system that children are going through, they are educated inside the four walls of a classroom and learning often happens outside it. This kind of a boundary is not preparing students effectively to become the global citizens of 21st century. Imagine a world where the boundary between formal and informal ways of learning are blurred, learning and education become synonymous and ubiquitous, independent of time, available materials, resources, previous qualification, pace and style. Technology, especially Mobile technology has the potential to achieve such a transformation.

## 1.1. What is Mobile Learning?

Mobile learning (M-learning) is an umbrella term usually used to describe learning that happens through the interaction with content in devices like mobile phones, tablets, palmtops, Personal digital assistants (PDA). McQuiggan et al. (2015) talked about mobile learning being less about physical devices themselves and more about the experience and opportunity afforded by the evolution of education technologies. They described it as "an anywhere, anytime learning enabled by instant, on-demand access to a personalized world filled with the tools and resources we prefer for creating our own knowledge, satisfying our curiosities, collaborating with others, and cultivating experiences

otherwise unattainable." Needless to say, mobile learning brings forth many new ideas for learning: personalization, collaboration, synchronicity and asynchronicity of interactions, peer-learning, mobility & accessibility, etc. all of which together was not possible before. Although, many devices mentioned above can aid in m-learning, the scope of the report focuses on use of mobile phones for learning in the Indian education context.

Modern mobile phones are devices that allow their users a variety of services such as calls, SMS's, e-mails, MMS's, internet access, to name a few. With increase of demand and improved technology, mobile phone manufacturers have been able to come up with advanced feature phones/smart phones at lower costs and improved battery life. This has led to a wider penetration of phones in areas that were inaccessible earlier in developing countries. With increased access and use, mobile phones have found various unconventional uses which include social networking, online shopping, instant messaging apps, live TV viewing and education to name a few.

Like every other revolutionary technology, mobiles have been associated with learning and education and have been promoted as a technological tool that could impact the process of learning. Mobile technology has the potential to disrupt the education system and provide novel ways of engaging students, thus making the learning experience more meaningful. They have the potential to bridge formal and informal learning. Applications developed for phones can be contextualized to adapt to local educational settings like localized language, inculcating local games in game based learning context, etc. It can help both in life-long and life-wide learning.

## 1.2. How are mobile technologies different?

Historically, there has been an effort to push every new technology into education by making gigantic claims about transforming the existing education system and education itself. The list includes camera, projector, television, radio, computers and now mobile technologies. When Skinner (1986) talked about personalizing education by using teaching machines, his ideas were limited to automating instructions for independent learning, targeted and self-paced lessons. Those machines had limited functionalities and had very specific use. Other technologies described here are limited in usability because of either their high cost and hence low affordability, low penetration, lack of mobility, huge sizes, technological disadvantages, etc. Mobile technologies, especially mobile phones are getting more affordable and the market is becoming bigger and deeply penetrative, reaching the most remote and rural parts of the world. They have very compact sizes, efficient battery life, multimedia support, interactive user interfaces, are available at cheaper prices, can be connected to internet, can be personalized, etc. They give the opportunity for users to learn, explore, collaborate and share anytime and anywhere. Due to the low purchasing power of people in developing nations, many households where PC's and laptops have failed to reach, mobile phones can be found in many households. Thus they provide a great platform with immense potential to bridge the digital divide in schools and outside.

McQuiggan et al. (2015) found through interviews with classroom teachers that mobile technologies added a level of engagement to any activity in the classroom and students enjoyed and were engaged in their interaction with mobile devices. They list a combination of factors that make mobile devices different from other technologies:

1. **Connectivity:** Instant and ubiquitous connectivity via Wi-fi, Bluetooth, etc. distinguish mobile devices from other technologies. In a study with undergraduate students, Dahlstrom et al. (2011) found out that 78% students considered Wi-Fi to be extremely valuable to their academic success. Apps like google drive, dropbox, slack, etc. provide amazing platforms of connectivity both inside and outside the classrooms.
2. **Awareness:** The range of sensors available on many of the advanced devices like camera, mic, touchscreen, geolocation, accelerometer, gyroscopes, etc. add multiple usable functionalities to the phone whose power can be harnessed in the learning process. Photos, audio and video recording, integration of Augmented Reality (AR), scanning, google maps, etc. can come in handy and provide many different ways of engagement when used for learning.
3. **Multimodality:** Mobile devices provide additional touch, command and movement based response, which can provide immersive engaging experiences. Students can broaden the possibilities of their work via integration of multimedia elements like audio, video images, songs, animations, etc.
4. **Familiarity:** Mobile devices are more familiar to use among children in the current generation as compared to other technological devices. A 2013 Pew survey (Madden et al., 2013) demonstrated that 77% families reported having at least one smart phone in their household, and 46% reported having at least a tablet. 43% children used a mobile device regularly and 74% of the teens used mobile devices to access the internet on a regular basis. Given the kind of familiarity, students will learn faster through the use of a mobile device as compared to other devices.
5. **Personal:** As compared to a personal computer, a mobile device is actually personal in the sense that it can be taken anywhere and used anytime and represents a more personal device than a PC. The portability feature adds to the popularity of the use.

6. **Relevance:** Mobile devices are relevant to the current generation of young people. They use such devices very often, thus it makes sense to choose mobile platform for learning over other technology platforms.

The catch, however, is that technology by itself is not the panacea for problems in education and it has been proved with all technologies so far. They should be viewed as the tools and means for and end goal and not and end in themselves. The education system needs to change and align itself so as to accommodate the technology and effectively harness its power. What this might look like with mobile technologies will be discussed in the report.

## 1.3. How can mobile technologies help in learning?

As mobile learning technologies developed, the opportunities for learning provided by m-learning increased. Traxler (2011) suggested the five ways in which m-learning offered new learning opportunities:

1. **Contingent Learning:** It is a form of associative learning from the environment and changes in it by establishing cause-effect relationships. In such a situation, teaching and learning activities are not pre-determined beforehand. Traxler (2010) and Bachmair and Pachler (2015) argue that compared to the desktop computer whose context was defined by the teaching context of the school i.e. standardized, fixed, timetabled, productivity-oriented, mobile phones have the characteristics of contingency and provisionality. Learners can react and respond to their environment and changing experiences. For a field trip, learners may gather and process data in-

situ in real-time and instantly follow up with investigations, based on their findings and their curiosity.

2. **Situated Learning:** This form of learning takes place in surroundings that make learning meaningful. The construction of knowledge in such cases takes place in situations and activities in authentic contexts (Bachmair and Pachler, 2015). In such a case, a lesson on history can take place in a museum where students with mobile phones and internet can search for more information, use chat messengers to interact and share information in real time, click and post pictures and videos of the artifacts.

3. **Authentic Learning:** It means that learning tasks are meaningfully related to immediate learning goals. Such learning should go hand in hand with situated learning. Students can learn about techniques for calculating age of an old artefact (carbon dating) by watching videos on mobile phones. This accounts for a more realistic and relevant learning experience. Traxler (2011) suggests that the above two should be a part of any vocational or professional course with a major element of work experience such as training to be a nurse, teacher, doctor, vet, etc.

4. **Context-aware environment:** Learning is informed by the history, surroundings and the environment of the learner. Benamar et al. (2013) describe context-awareness as the embedding of learning activities into everyday life or work through mobile devices and services. This involves design of pervasive learning systems where there is the timely provision of delivery of relevant material for specific tasks in specific situations. One example of this is augmented reality (AR), where learners can use mobile phones on a field trip to gather data or information about

certain areas in the space by using camera (geotagged locations) and or GPS on their mobile phones.

5. **Personalised Learning:** Learning can be customized for individual learner to cater to the needs, abilities and interests. Dede (2008) noted that learning was a human activity that was quite diverse in its manifestations from person to person. Mobile phones offer a platform to personalize learning for every individual and simultaneously offer a wide range of resources at the right level of the individual.

Traxler (2010) commented the following on mobile learning spaces:

> "Mobile devices demolish the need to tie particular activities to particular places or particular times. They reconfigure relationships between public and private spaces, and the ways in which these relationships are penetrated by virtual spaces. Virtual communities and discussions were previously mediated by static networked PCs in dedicated times, places and spaces. Now, mobiles propel these communities and discussions into physical public and private spaces, forcing changes and adjustments to all three as we learn to manage a more fluid environment. (p. 59)"

Bachmair and Pachler (2015) argued that the learning space for mobile technology is being reconstructed by its learners. They noted that the spaces in which young people take photos, use text messages, share their learning and investigate further through specialized apps, are losing their traditional forms and functions. Instead, they are becoming contextual environments. Clearly, mobile phones have the potential to redefine the learning space in novel and exciting ways never possible before, provided they are used in the right way.

# 2. FRAMEWORKS FOR MOBILE LEARNING

Crompton (2013) described pedagogies, technological devices, contexts and social interactions as the four central constructs of mobile learning. Crompton defines mobile learning as "learning across multiple contexts, through social and content interactions, using personal electronic devices." Learning can be directed by others or by self, it can also be an unplanned, spontaneous experience, the setting can be formal or informal and the physical environment may or may not be involved in the learning experience. Mobile devices favour learner centred pedagogies and hence it becomes important for learning theories that describe mobile learning to consider the learner and the way they learn.

## 2.1. What are the learning theories behind mobile learning?

Learners are no more considered as empty vessels waiting to be filled with knowledge, thus discarding the *tabula rasa* (Latin for blank slate) approach. There has been a considerable shift in the ideas of learning from the transmission of knowledge to the active creation of knowledge in learners' minds. It was Piaget (1929) who first posited that young learners had complex cognitive structures for learning, and intellectual development happened through environmental stimulations. Crompton (2013) noted that it was after Piaget came up with his cognitive theories for learning that learner centered pedagogical approach commenced. I mention here three modern theories of learning that could describe the characteristics of mobile learning better than others: Constructionism, Socio-constructivist learning and Connectivism.

1. **Constructionism:** Papert (1980) developed his theory from constructivist ideas of learning. He suggested that students learn best when they were actively involved in constructing social objects and learning was a reconstruction of knowledge rather than a simple process of transmission. The theory suggests that students use the information and ideas they have to acquire more knowledge and advocates learner centered, constructivist and discovery learning processes. He co-created the LOGO programming language for children and made his idea clear that children could program the computer, create and manipulate meanings through their creation. Papert (1993) argued that many children learn difficult videogames without any professional teaching and hence makes the case for the idea that if children want to learn something and have the opportunity to learn it in use, they do it in spite of no or little teaching support. In a similar way, children can learn to use the mobile phones and then interact with the content present with little or no support. Through touchscreen interaction, experimenting with the multimedia features like audio, video, camera, etc., they can learn about the features in the phones and use them to do complex tasks that require them to use such features. Students can work on a project that requires them to take pictures of a particular plant species, use the internet to search for more information about the plant species, document their findings instantly in applications like Google Keep or Evernote. Csíkszentmihályi and Rathunde (2005) found that constructivist methods of teaching and learning, as demonstrated in Montessori schools, were more engaging for students when compared with instructional methods of teaching. Thus, constructionism methods of teaching using mobile phones can achieve higher engagement levels among students and keep them motivated for long.

2. **Socio-constructivist Learning**: According to this theory, knowledge is co-constructed in the interaction of individual with the social process. (Sullivan-Palincsar, 1998; Vygotsky, 1978).

Crompton (2013) noted that the tenet of socio-constructivism is that intellectual advancement occurs through interactions within a group. This has been evident in the social networking websites like Facebook, twitter, Instagram, etc. Mobile phones offer instant messaging applications like Whatsapp, Snapchat, etc. which involves sharing of information and demonstrates co-construction of knowledge. Students working in a group or individually can share information via photos, videos, animations, URL's and hence create a community of learners in the process where the overall knowledge accumulated is a result of contribution of every individual in the platform of sharing. Learners will have the freedom to pick and choose the kind of topics they are interested in and can delve deeper and create focused groups based on similar interests, experience, etc.

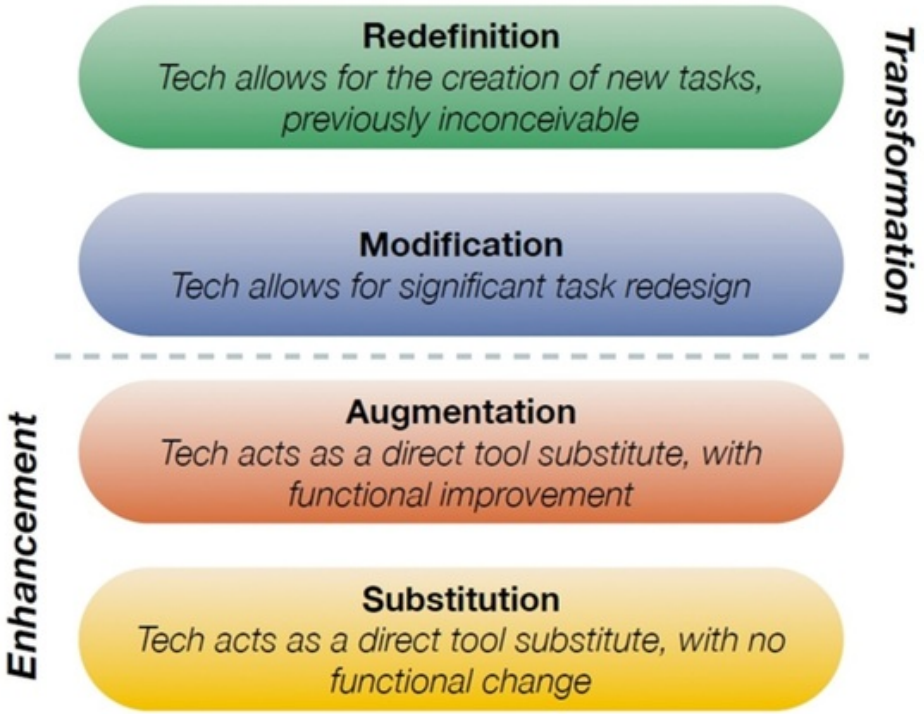
3. **Connectivism**: Siemens (2005) argued that theories like Behaviorism, Connectivism and constructivism were developed in a time when learning wasn't influenced by technology. As technology has shaped the way we live our lives, communicate with each other and how we learn, it was important according to Siemens to come up with a new idea of learning that was relevant in the digital age. He referred to the development of information and the life of knowledge which was measured in decades in the absence of technology. According to the American Society of Training and Documentation (ASTD), the amount of knowledge in the world has doubled in the past 10 years and is doubling every 18 months. He argued that in such a fast moving world, learners would not have the privilege, time and experience to acquire the learning that needs us to act instantly and make immediate decisions. In such a situation, we would be deriving competencies by forming connections with others. According to Siemens, the following are the basic principles of his theory:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is in itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Mobile learning applies perfectly well to such a learning theory. Connected to the internet allows us to be connected to smaller or larger groups, derive information from the internet or from such groups, make instant decisions based on the most updated information available (choosing to go out or stay home depending on the weather information). An online poll with the group of students can give immediate feedback on the understanding of a particular thing taught or learnt.

These learning theories mentioned above also help in creating a pedagogical framework to create and support novel learning environments. Some examples have been described below:

Puentedura (2014) used the SAMR (substitution, augmentation, modification and redefinition) model for technology integration. In this model, technology can be used either for enhancing the lessons (using a multimedia presentation, digital textbook, etc.) or for transforming lessons by fostering deep learning through creation of tasks by students (creating a digital project through programming, creating a slideshow/video project, etc.). Puentedura argued that as a lesson moved from augmentation to modification, opportunities for learning increased.




(Image Source: http://www.schrockguide.net/samr.html )

Mobile learning allows for reimagining traditional forms of learning. This can be realized in the cases of Blended and Flipped Classrooms. Blended learning involves blending learning from various sources, one of which involves technology. Students can learn from online content at their own pace and find resources that are aligned to their interests. Flipped classrooms are a subset of blended

learning where students are presented with content knowledge outside of the school through mobile devices. Inside classrooms, students get more time to deepen their learning by collaborating, interacting with other students and performing creative exercises based on the content knowledge acquired. This form allows students to take time and learn any material at their own pace outside their schools, in a personalized environment. This presents opportunity for collaboration outside schools as well, where parents, siblings, friends can learn together and help each other. Students can explore more about any topic using the internet at home and share their learnings with their peers. Interacting with peers and teachers outside school can lead to supporting informal inquiries and learning outside the school. It also results in more teacher student interaction time and hence more opportunities inside the classroom for activities like project based learning. Teachers can also draw inspiration from popular and relevant activities like social networking and playing games and integrate them into learning process. Charier (2012) reported of Math teacher Kristianna Luce who used *Angry Birds*, the popular mobile game for teaching parabolas and quadratic equations. Thus, blended learning using mobile devices present a way to bridge formal and informal learning.

McQuiggan et al. (2015) noted that there could be 4 different levels of access to mobile devices inside the classrooms:

1. A teacher in the class with a single mobile device, where teachers can use the device to manage the class activities.
2. 1:1, where each student has a personal device.
3. Many: 1, where many students share a device.
4. BYOD (bring your own device), where students bring their own device from their homes

Mobile devices present host of other opportunities like homeschooling, virtual schooling and other alternative learning environments. This can cater to student absenteeism, school shut downs due to unforeseen circumstances and provide students with disabilities a chance to learn at their own pace in their own comfortable space.

## 2.2. Strengths and Limitations

McQuiggan et al. (2015) note the following as the general benefits seen in mobile learning:

1. **Ability to learn on the go:** Mobile devices do not restrict the learner to any context be it the walls of the classroom or the world outside it. It truly makes learning independent of the time and location.
2. **Reach undeserved children and schools:** The low price of mobile devices, especially phones (almost 6 times cheaper than a desktop PC) can cater to the low purchasing power of rural populations in various parts of the world. This outreach and penetration has the potential to bridge the digital divide in the current generation.
3. **Improve higher order thinking skills:** Mobile devices combined with internet can foster the much talked about 21st century skills: Problem solving, Communication, Collaboration and Creativity. One example in use the EcoMOBILE (http://ecolearn.gse.harvard.edu/ecoMOBILE/design.php) project where students can take their mobile phones on a field trip to a real pond environment. Powered by the integration of AR and probes for data collection from the environment, EcoMOBILE provides students with realtime

information about the environment which helps them conceptualize and discuss and hypothesize complex relationships between various environmental parameters.

4. **Support alternate learning environments:** Mobile devices can support learning in alternate learning environments like flipped classrooms, blended learning environments, virtual environments, homeschooling, etc.
5. **Enable personalized learning:** Mobile devices can be used to present learning content at the right level of the learner (not too easy and not too challenging), and also at a pace that is determined by the learner.
6. **Motivating students:** When students have a perceived control over their learning space and materials, they tend to be better engaged (Shernoff et al., 2003). Having their own devices allows a sense of control, if at all partial, over the learning environment and can lead to higher engagement levels in the interaction and can potentially keep the students motivated in the long run.

Mobile learning comes with its own set of unique challenges. McQuiggan et al. (2015) present the following as some of the general challenges faced in mobile learning:

1. **Differentiated access to devices and internet:** This refers to the availability and cost of broadband in schools and homes which can pose a hurdle for low income families and rural areas. Procuring the devices in the first place involves a cost factor which might prohibit under-resourced schools and low income families to invest in such technologies. Thus access to devices in such a case might not be equal and create a divide among those who have and those who don't.
2. **Use must be monitored:** While technology is being used in classroom or outside of it, they use needs to be monitored in some way. Mobile devices with internet present the possibility of being a distraction, being misused or used for the wrong reasons. There are health concerns related to

overuse, privacy concerns about oversharing personal information. Use of such devices in schools would increase their responsibility to educate the learners and make them aware of the misuse. There must be an informed policy guiding the use of such devices in classrooms. Parents and teachers must be informed about the research and implications of using such devices so that they can partake in the process of effective use of mobile technology.

3. **Prevailing attitudes and prejudices against using technology for instruction:** Johnson et al. (2012) shared the findings about prevailing attitudes and prejudices against using technology for instruction and noted that the system remains in a way that reinforces traditional educational methods. Effective incorporation of mobile technologies involves discarding existing structures and many stakeholders are resistant to make this shift. There are still laws that prohibit the use of mobile technologies in the classroom categorically. This was demonstrated in in New York (2006) when city mayor Michael Bloomberg banned the use of cellphones in the city's public schools. Such actions might lead to complete dismissal of mobile technologies without harnessing its true potential. A more informed discussion needs to be done at the policy level and the use allowed, with guidelines specified on the use inside school. Benefits like Bring Your Own Device (BYOD) need to be considered while creating policies for mobile learning. McQuiggan et al. (2015) presented the case of schools in Forsyth County in Georgia (2014), which reported less in-class texting and off-task behaviour on cellphones when they had BYOD for schoolwork.
4. **Limiting physical attributes:** Having smaller size means having lesser capabilities as compared to a PC or a laptop. Smaller touch interface, limited memory, smaller screen size all can make them more difficult to use.
5. **Device sharing in a group:** Sharing devices in a group over one to one usage can impact the functionalities and benefits. Roscorla (2011) suggested that in the above case, using them could result

in less engaging and more difficult experiences. The learning here is less personalized and more shared.

6. **Ways of implementation impacts their effectiveness:** Dede et al. (2014) noted that if we limited the implementation to a model of acquisition and distribution of mobile phones, then the technology won't work wonders by itself. The system will have to mould itself in order to integrate the technology, curriculum and pedagogies will have to be shaped and the ideas of classrooms and lessons will have to be rethought to maximize the effectiveness of mobile device integration and realize the benefits mentioned above.

# 3. INDIA AND MOBILE LEARNING

## 3.1. Why is India special?

This literature review explores how education and learning can happen through mobile phones in India. India is a land to 1.28 billion people. It is also the 3rd largest smartphone market in the world (Pathak, 2015). According to a report published by Telecom Regulatory Authority of India (TRAI, 2015), the total number of mobile phone users in India was 952.34 million out of a total of 979.21 million (mobile + wireline) users as per January, 2015. The monthly growth rate was 0.89%. Interestingly, 58.11% of the users belonged to an urban population while a comparable 41.89% belonged to rural areas. According to IAMAI's report, India is also the 2nd largest number of internet users (354 million) by the end of June 2015 (Dazeinfo, 2015). 213 million of those accessed internet from their phones (60% of the total internet users) and a sizeable chunk belonged to the rural population of India. The number of mobile internet users is estimated to go up to 314 million users by 2017. According to a Nielsen report (2015), 48% of the smartphone users were in the age group of 18-24 years in 2013.

In the Indian population, 442 million belonged to the age group of 6-23 and literacy rate was 73% in the age group of 7-14 and 69.3% in the age group of 15 and above as per 2011 census data (Ministry of Human Resources and Development (MHRD), 2015). While the enrollment ratios in schools have been more than 90% in all age groups, the dropout rates have been increasing significantly with the increase in age.

As a teacher in a public school in Mumbai as a part of the Teach for India fellowship, I taught Science, Math and Social Sciences to 44 sixth and seventh graders over the course of two years. Located in the

suburbs of the city, the community and the neighborhood of the school was essentially a low-income community where majority of school going children were what can be called first-generation learners. Their parents either never went to school or dropped out before completing secondary schooling. None of my students' parents had a degree and worked with meagre earnings trying to support the families. I conducted a survey with my class where 42 families participated. The survey contained a set of questions which students and their parents answered together during a parent teacher meeting held in the school. I translated the meaning of questions (originally in English) and parents answered them with the help of their children. The questions included family size, household income, spending, availability of electronic devices, etc. I found out that every household had at least one mobile phone and around 40% families had a smart phone. A small number of them had internet on their phone. Students in my class spent their time on those phones, whenever they had it at their disposal, on playing games, listening to music, chatting, taking pictures. They learnt everything about the phones and their usage on their own and along with their peers. Parents used the phones mostly for making and receiving calls and some of them were savvy enough to communicate through SMS's. Students were not allowed to bring phones to schools. My school had a defunct computer lab which was never used for computer education. There was an ICT instructor and ICT was a subject in the curriculum for grades 8 and above. Although there was a TV with a computer which was used for delivery of lectures from a central location, students sitting in the lectures were never engaged in the online delivery of lectures. This was a perfect example of bad use of technology in my experience.

The statistics present India with a huge opportunity for implementing mobile learning projects and initiatives in schools and yet there has been a very limited number of research carried out on mobile learning in India.

## 3.2. Research in Mobile Learning

This section covers some examples of research done in the field of Mobile Learning in India.

Kam et al. (2005) used their findings from previous ICT pilots in Uttar Pradesh that principles for designing educational technology for developing nations were to be different from developed nations and they should include constructivist, small-group collaborative learning through digital storytelling and integration of paper-based with computer based activities. They found that collaborative and peer-learning was evident in the learning process, students were proud of their accomplishments and personal success in creating digital artifacts but had limited time in the school schedule for the use of computers in the school. Students faced a lot of challenges in using the technology, especially using PowerPoint, schools had a specifically designated room for computers and had a limited space in the room. Students preferred mobile and compact devices over the big sized desktops and paper based artifacts were more accessible to them. There was a lack of parental support for their children's schooling in those rural areas.

Kam et al. (2006) suggested Participatory Design (PD) with children to come up with better designs for intended children users. They proposed full participation of children, especially school going children, in the design of educational softwares. They referred to Druin (2011) who identified four roles that a child could play in the design process: (a) as a user of systems whose lifecycles have ceased (b) as a tester of prototypes under development (c) as an informant who provides designers with inputs at any stage of design process (d) as a partner who negotiates group decisions with adult team members as an equal. In Digdarshan initiative in Uttar Pradesh, the researchers involved students to be members of the design team as partners. They found that adult researchers needed to develop a

relationship with children that was fundamentally different from a teacher student relationship. There needed to be a genuine interest displayed by researchers in learning about the local language, culture and lives of the child facilitators and children as a method to build trust and meaningful partnerships for the design process.

Kam et al. (2008) proposed mobile games on cellphones to be effective for learning ESL (English as a second language) in a rural under-resourced setting. Such games had to be educational as well as pleasurable for the target users, who have limited exposure to technology. They proposed the reception-practice-activation cycle for informing designs of such games. They suggested maintaining a distinction between learning and fun to some extent for effective designs. The receptive phase developed competency like vocabulary, alphabet, etc. in ESL. The activation phase tested the player on something they learnt in the receptive phase. An image of a talking parrot game has been shown below (from Kam et al., 2008).


**Figure 1. The receptive phase (left) and activation phase (right) in the initial parrot game. The learner was being taught "A" among other letters in the receptive phase and was tested on the letter "E" in the activation phase shown.**

They found that there were significant gains in learning while playing the games. The content was relevant and dated. Kam et al. (2009) conducted a semester-long pilot on mobile learning in collaboration with an NGO in North India. The study was conducted in an after-school format where participants were 27 children who passed a basic numeracy and ESL test. The study included mobile phone training to start with and proceeded with ESL learning and concluded with an assessment. The ESL sessions followed a specifically designed curriculum with a set of ESL games on mobile phones. Assessments showed that participants had an increase in post test scores, high scores were obtained by students in higher grades v/s lower scores which were obtained by lower grade students. This showed that higher levels of Hindi literacy and academic preparations was associated with higher post-test gains. They also found that academically weaker students gained from a teacher directed pedagogy while academically stronger students benefited from a self-paced self-directed mobile learning approach. Kam et al. suggested peer coaching strategies for intervention in such situations.

Kam et al. (2009) found that some digital games failed to match rural students' understanding of games in general and hence conducted studies on informing the design of games that could have a greater engagement level with rural children. They took cues from traditional village games into game design patterns to make the process culturally meaningful to children. Game designs included the number of players involved in traditional games and the roles of the players, goals of each player, rules, models and actions in the games. They acknowledged that games had to be challenging but at the right levels, without being too difficult. Some examples taken from their research are shown below:

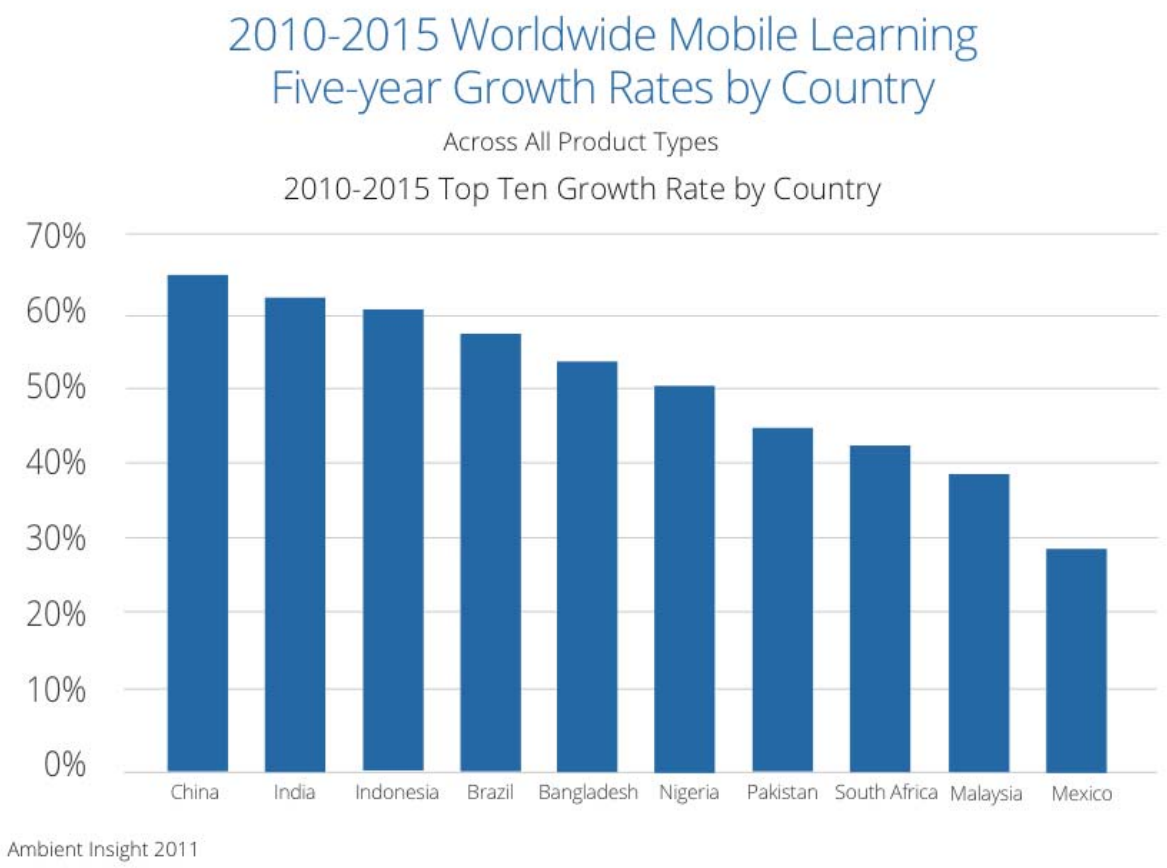
**Figure 3. Tree-Tree game, mirrored after "tag" village games.**


**Figure 2. Some of the traditional village games that children in India play: (A) Gucchi Garam, (B) Siya Satkana, (C) Giti Phod and (D) Halla Guli Mane. In (A), a player stands in the safety of his circle and deflects a ball before it hits him. In (B), a player reaches to pick up the stick while avoiding being touched by the "it" player. In (C), a team attempts to rebuild the rocks into a heap while avoiding a ball thrown by the opposing team. In (D), players aim to move all the tamarind seeds into one crevice on the tray.**

Kumar et al. (2011) used mobile games to conduct studies on ESL studies and found that using games, learners who articulated a word aloud was more advantageous for learning than silently practicing it. They findings corroborated the finding that oral production of language was critical for new learners of a language as an oral output provided specific input back to the mind, which in turn assisted a learner to transition from declarative knowledge to productive knowledge (De Bot, 1996).

Tata Interactive systems (http://www.tatainteractive.com/mobile_learning.html) and CommLab India (http://www.commlabindia.com/learning-technology/mobile-learning.php) are a couple of the established organizations working in the area of mobile learning in India. A report by Ambient Insight, India (2011) presented India second to China in sales of mobile learning products with a growth rate of

61.3%. This shows a great potential and a growing market for m-learning to happen in India.




*Ref: Ambient Insight Report "2010-2015" Worldwide Mobile Learning Market estimate*

(Source: https://www.docebo.com/2014/12/03/mobile-learning-market-india-docebo/ )

Research done in mobile learning has been limited to small groups and pilot studies and have not been used to inform policies to create larger movements in the sphere mobile learning. It is clear from previous research that applications, programs and initiatives, especially in rural and semi-urban parts of the country using mobile learning will have to follow learner centered design and take the user into account in the process of design to engage children in meaningful experiences and produce an actual impact. Using standard games/applications or replicating a successful program in another corner of the

world would be less useful and impactful in the Indian context. Mobile learning initiatives will have to be implemented at a larger scale in order to have sturdier findings for a large population and inform policies and further research in general.

## 3.3. Analysis of policies in India for ICT/Mobile learning

This section analyzes the National Policy on Information and Communication Technology (ICT) in school education (2012) to understand the scope, critique the document and provide suggestions for modifications to accommodate Mobile learning.

The document needs to be commended for its vision on using technology to enhance outreach, reduce the inequity and to improve quality in education. There has been a focus on integrating technology in education since 1992 as mentioned in the document. Use of ICT for improving quality of education has also been mentioned Sarva Shikhsa Abhiyan program (the Education for All movement) and other recommendations. The document serves as a comprehensive guide for schools to create, promote and motivate an ICT literate community which can collaborate, cooperate and contribute to building a knowledge powered nation.

For the purpose of the document, ICT has been defined as “all devices, tools, content, resources, forums, and services, digital and those that can be converted into or delivered through digital forms, which can be deployed for realising the goals of teaching learning, enhancing access to and reach of resources, building of capacities, as well as management of the educational system.” It also includes hardware devices and software applications, process of digitization, development and deployment of content. The problem with such a broad definition of computing technologies is that it doesn’t go into

detail of technologies that are similar or different. It tries to combine and evaluate all technologies as having the same capabilities and potential under one umbrella term of ICT. A desktop computer has its own benefits and implementation challenges and is significantly different from those of a laptop and a mobile device in many aspects. Thus, an umbrella term for defining the technologies is not a wise way of categorization. It misses out on the intricate details, benefits, implementation challenges and requirement of settings. Thus, the broader term of ICT does not serve as a useful framework for defining a host of different technologies and a better way would be to include the term ICT but provide more detailed guidelines for trending technologies like mobile devices, laptop computers, etc.

The policy document provides comprehensive guidelines for usage of ICT i.e. for literacy and competency development by suggesting adaptations to local contexts and categorizing users as having basic, intermediate or advanced computer proficiencies. This is useful in determining the initial levels of students in computer literacy. The document however presents ICT in a subject format and provides literacy curriculum frameworks, evaluation schemes which evidently suggest that the term ICT narrowly points at desktop computer for classrooms and programs around them. This is evident in the following:

> "4.2.2 A model Curriculum for ICT in Education (CICT) will be developed at National Level and States will be encouraged to adopt/adapt it.
>
> 4.2.3 States will develop an ICT literacy curriculum and appropriate course materials mapped to the stages mentioned above for uniformity. These will be in the form of self-instructional materials, enabling students and teachers to process them on their own. The ICT literacy programme will endeavour to provide a broad set of generic skills and conceptual knowledge and not focus on mastering the use of specific software applications."

The framework limits the ICT literacy as a separate subject and not something which students can learn about on their own. Prof. Sugata Mitra's famous "Hole in the Wall" experiment demonstrated that groups of children can learn to use computers on their own (Mitra et al., 2005). Also, such guidelines don't represent mobile devices which children are having increasing and easy access to. The document mentions ICT for enabling teaching and learning process and encourages use of ICT for simulations, multimedia support, virtual learning environments, etc. It also encourages teachers to be part of the content evaluation and creation process and provides guidelines for use of ICT for vocational education, children with special needs, open and distance learning, and school management systems. There is no mention of mobile learning in the document specifically and an inherent assumption that frameworks and policies mentioned will be applicable and valid for every technology in general. While mentioning hardware for ICT, there is specific mention of computers and audio-visual aids. The document does not take into account the possibilities provided by novel technologies like mobile phones and tablets. Although the document presents developing alternate schooling models as a challenge and states wisely that "each such device or strategy also involves changes in the classroom environment, and its bearing on effectiveness" it does not provide model examples like Flipped classrooms, blended learning classes, informal learning that can effectively use mobile devices for improving learning. There are terms like "ICT Enabled class" which need to be defined well in the document. Although the document highlights many areas of ICT intervention, it gives an impression of a static and stagnant classroom structure for ICT integration. It goes against the very nature of mobile learning which can disrupt existing models of education and need not have a classroom environment for integration. Also, integration of new technologies relies on the fundamental principle of rethinking ways of designing learning environment to integrate the

technologies. Attempts to integrate technologies into existing models of education will not result in any significant impact as has been seen historically.

UNESCO's report on mobile learning in Asia (2012) presented similarities to policies existing in many Asian countries and worldwide. The report found that although several countries had strategic plans for ICT integration in education, they did not address mobile technologies explicitly and most learning projects implemented were ad-hoc and small-scale. It showed that mobile learning in the Asian region was yet to move beyond the emerging and experimental stage and the same is reflected in India. It noted that countries like India and Bangladesh needed to consider mobile learning specifically since mobile phones were affordable and met the low-purchasing power of people in the rural parts of the countries. India had 61.4 number of mobile phones per 100 inhabitants as compared to 6.1 % households with computers (ITU, 2011c). Indian policymakers need to leverage the benefits of easy access and the outreach of the mobile phones. Mobile phones and markets have penetrated deeper than any other technology (laptop, desktop computers) in the various parts of India and this near ubiquity needs to be taken into account seriously if we intend to bridge the digital divide and education inequity in the near future.

## 3.4. Recommendations: Policies and Initiatives

McQuiggan et al. (2015) noted the following as important factors that could determine the success of mobile learning:

1. **Professional Development:** Teachers, school leaders, school districts should be trained to use the technology effectively. The teaching programs must make use of mobile learning and

relevant pedagogies to train the teachers to be effective in the use of mobile technologies in classrooms.

2. **Using data to personalize learning:** Mobile devices allow novel ways to interpret data in form of logs and screen trackers which can be used by teachers to learn better about the students. Assessments and progress can be tracked in new ways and this can help the teacher provide a more personalized experience of learning for the students.
3. **Changing instruction:** Integrating mobile learning involves rethinking about learning and usage of mobile phones. Adding apps to automate instruction will be of no use and have no impact in the long run.
4. **Flexible policies:** Banning mobile phones without considering the situation carefully will present barriers to integration of such technologies. McQuiggan et al. advocate that lenient and carefully thought policies need to be made while considering mobile learning for classrooms. Such policies must make room for clarity and detailed guidelines and promote ethical and responsible use of device.
5. **Good content:** Apps and contents must be aligned to the content taught in classrooms and should be localized to cater to contextual requirements for providing effective balance to mobile learning programs (use of local language for assistance, cultural elements in storytelling and games, etc.)

From a policy perspective, UNESCO's report suggests a collaborative approach to introduce mobile learning effectively into education system of countries and that holds true for India as well. There needs to be a fairly robust technological infrastructure (internet connectivity, electricity, etc.) in place before mobile learning can be initiated. Older students are more likely to have their own mobile device as compared to younger school going students. Thus the cost and affordability becomes a concern in

the case of schools. Universities are not expected to provide devices to students and hence it becomes easier to implement mobile learning in universities. For schools, subsidizing or providing devices for free can be a viable option. Higher educational institutions have established partnerships with telecommunications companies for mobile learning initiatives (KT, LG and Samsung in Korea). Flexibility and autonomy in terms of curriculum design and strategic planning, which are a characteristic of universities are important factors for flourishing of mobile learning programs. Governments and higher educational institutions play a major role in encouraging mobile learning in Asia. Other important stakeholders include regional and local educational authorities, telecommunication providers, students, parents, teachers and scholars.

The report describes the three levels at which interactions between various stakeholders can take place to promote mobile learning. At the macro level, ministries of education and policy makers can make policies, provide broad guidelines and frameworks for nation-wide implementations. At micro levels, teachers, school administrators, parents and students help in the implementation of small scale and concrete projects that cater to local needs. At the meso level, NGO's, research institutions and private organizations can start mobile learning initiatives in the micro level and provide findings and results at the macro-level to help in policy formulations and help translate macro-level policies into practice. They can also work with micro-level institutions to report at the macro-level on the effectiveness of the policies at the grassroots (Jephcote and Davies, 2004). The model presented above is largely dependent on the successful cooperation and collaboration of stakeholders at all levels for sustainability and scalability. The relation between the 3 levels does not suggest a linear relationship among them in their functioning (Radford, 2008) and an ideal scenario involves co-evolution and self-organizing of stakeholders at all three levels while shaping each other in the process (Uhl-Bien and

Marion, 2009). According to the report, Singapore provides an excellent example of successful interaction between micro, meso and macro levels. It has several micro level initiatives in place and has government support for such initiatives. Yet, it needs to have specific mobile technology policies in place to realize the full potential of such technologies.

Dede et al. (2014) suggested the following key plans for implementing successful local mobile initiatives:

1. **Purposeful planning for mobile device usage:** Mobile devices can provide various avenues for deep learning and engaging and active forms of interactions. But simply acquiring and distributing mobile phones in a setting won't magically produce any change. It is important to understand and lay out the learning goals that needed to be achieved by such intervention (on cognitive, interpersonal and intrapersonal levels), know about the learners and teachers and their prior skills and experiences they have, the instructional materials or curriculum that is required or needs to be developed for the specific purpose and the metrics for evaluating the effectiveness of the programs
2. **Leveraging content and curriculum that is mobile empowered:** The content must be available in formats compatible with mobile devices. There must be a balance between active and passive forms of learning. The content must be catering to the right level of difficulty for individual users. Alternate modalities and availability of content in one's local language increases effectiveness of such content.
3. **Understanding the power of internet access:** Internet can be considered a gateway to a world of rich and diverse resources that can enrich the learning process for the learner. Limited or no access to internet on the devices will limit or diminish the opportunities that would have been otherwise important to increase the power and functionality of the device.

4. **Preparing educators effectively:** Dede et al. argue that the effectiveness of a mobile learning project will eventually depend on the quality of educators involved and that the innovation is not in technology but in the empowerment of human resources involved in the process by changing the ways in which education is structured and delivered. Professional Development involves unlearning the previously held beliefs and ideas and requires that teachers experience the process of learning through the same technology. Teachers must have a strong commitment for professional development and be willing to incorporate new technologies and pedagogies to improve their teaching.
5. **Securing leadership buy-in:** Since the implementation of such new initiatives would require strong leadership skills for implementation and mobilization of resources, it is important to have the right leaders who would take the project forward towards success.
6. **Building personal learner efficiency and capacity for self-directed learning:** The long term goal should include building academic tenacity and mobile phones can be used to develop the same (US Department of Education, 2013). Even though mobiles can provide with instant engagement, it is important to persevere in the lack of engagement and undergo the discipline of practice to become better at the activities that one pursues at that moment. Mobile initiatives must be designed keeping in mind that the relation between momentary engagement and continued involvement is not simply reciprocal reinforcement.
7. **Creating an ecosystem that is sustainable and scalable:** Achieving scale in education requires designs that can flexibly adapt to effective use in a variety of contexts across a wide range of learners and educators. According to Clark and Dede (2009), scaling up can have the following characteristics:

a) **Depth:** designing informed by research and evidence and evaluating the causes of effectiveness.

b) **Sustainability:** Robust design that can adapt to unknown circumstances and sudden changes

c) **Spread:** Continuously improving to retain effectiveness while reducing resources and expertise required.

d) **Shift:** involving end users and co-designers and co-evaluators in the process of design

e) **Evolution:** learning from user's adaptations to rethink about the original design model.

# 4. CONCLUSION

UNESCO's report (2012) on mobile learning indicates that the focus of mobile learning initiatives in Asian countries is currently on providing the basic literacy and knowledge acquisition. It identifies that mobile phones are being portrayed as able tools for serving the above purpose. Yet, there are not many projects that have explored the potential of mobile phones for deeper learning or knowledge creation. It suggests that going forward, the Asian region would require a macro-level plan for countries to basic education and knowledge acquisition to learning that focuses on knowledge creation. Stakeholders at various levels will have to explore this aspect of learning through the use of mobile devices. By creating a vision for the future, leveraging the potential of mobile devices, and developing comprehensive policies and implementation plans, Asia can create a more equitable education system for all. As for India in specific, mobile phones in education holds a tremendous opportunity for bridging the digital divide and educational inequity and their role needs to be explored at all levels (macro, micro and meso). Having the basic technological infrastructure for successful introduction of mobile learning is a pre-requisite to any mobile learning initiative. India must aim to provide the same before it can think of scalable and sustainable initiatives. More focused policies for mobile learning will have to be created and a stronger collaboration among all stakeholders would be needed. Finally, it is leadership that will drive the programs to success. Stronger leaders at all levels who have a vision to integrate mobile technologies in education will be essential to initiate mobile learning programs and policies and enable the education system in India to utilize the opportunity provided by mobile technologies to its fullest.

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