

A novel use of ICT to deliver just-in-time educational aid to help better learning for the school students in developing countries

1. Introduction

The biggest challenge in the education sector of the developing countries is the high student to teacher ratio. As a result, often times, it is not possible to guide each student equally that it creates a gap among students in terms of understanding of their lessons- some understands, some loses motivation to learn as they miss the rationale behind. As Underwood et al., (2009) argue, the online education initiative has been taken to improve the situation. However, the effect is still unknown but assumed to be positive. Many argue, ICT “positively affects all the stakeholders of the education field” (Tikam, 2013). Contrarily, some studies indicate that children spend a vast part of time playing computer games, (Malamud & Pop-Eleches, 2010). Belo et al. (2014) find that in context of Portugal, broadband connectivity has had negative impact on the grades of high school students.

There is a lack of comprehensive research on the effectiveness of online education available to develop effective general policy that can be useful for all levels of students. On top of that, in the developing world high expense of ICT tools creates barrier to entry for the ICT based educational tools and causes slow diffusion. Hilbert (2010) argues that in the context of the Latin America, reduction of ICT prices may see better diffusion. Hence, in the developing world, learners have limited access to online based resources like video lectures, study materials, etc. due to poor connectivity or high expense. Alternative media such as TV, Radio has limitation on schedule time and lack of interactivity make them difficult alternatives.

Can different use of ICT help in this regard? We have developed a prototype to test if just in time guidance from experts using ICT tools such as mobile telephony, is useful for learners countrywide. The model can be helpful for government & policy makers to replicate and provide a space for learners towards self-study. Recently the use of mobile devices for daily needs has reached every corner of developing countries like Bangladesh. Controlled use of mobile devices for daily teaching-learning can be helpful for learners. Our hypothesis is, students lose motivation to learn a topic if they lack timely guidance. We argue that, lack of motivation to learn could be added to the list of socio-economic reasons behind the high drop-out rates in the developing world. As the students fail to grasp lessons learned in the school, they may resort to self-study. However, if while self-studying the students stumbles upon questions that they cannot resolve, they may lose their eagerness to learn forever. Hence if there is a way to give them a just in time educational aid that he or she could avail easily, the student may get renewed interest in learning. We try to incorporate ICT based interventions to give ‘just in time education (JINTE) The idea is : while self studying, if a student faces problem in understanding a topic, he would have someone to help him understand via ICT based simple Q/A tool. A low cost and on time alternative to internet based education can help millions of school going students in the developing world where educational content is scarce and teacher-student ratio is very low. The

research question we try to answer is related to finding an ICT based solution to this problem. We ask:

Can mobile based just in time education improve the quality of teaching and learning in the schools of the developing countries?

In this paper, we describe the idea of JINTE, the technological overview of the system, and some case studies of the successful use of JINTE at different schools in Bangladesh. The results of our studies may help education-ICT policy makers to define and design ICT based education in the developing world.

2. Legacy Education

The education system is same in all levels where teaching is generally one-way delivery. For example, teacher has some planning on class lecture and he tries to cover his lecture to complete the syllabus on time. As the class time is limited and teacher has to consider the syllabus thus teacher may ask few question to the class. The purpose is to get an understanding on how much learning have absorbed by the students on delivered lecture. As it is not possible to ask each student to understand their learning thus only bright students respond and majority of the class is not able to participate for providing feedback on their learning success. Teacher has a measure of the whole class on the basis of a small group of participants (usually the bright ones) who answer questions. Again, class test & Mid/Final exam is taken to measure the performance of a student. The intention of the teacher is good; however, a distance is created between the weaker students who the teacher wishes to actually address through his probe questions.

Yousuf et al., (2006), describes the followings to be some of the problems in legacy education system:

- Only brighter students respond
- Students feel shy to participate
- Motivation to focus on class and participate in interactive discussion
- Scope for the teacher to tailor his delivery on the basis of previous lectures

However, it is widely believed that there is no better way to learn than face-to-face learning. The benefit of legacy education might be found in 1:1 teacher student ratio which is impractical. Developing countries like Bangladesh has 1:32 teacher to student ratio (BANBEIS, 2012a) for college education and this is still large for personalized care for each student. Yousuf et al., (2006) gives a comprehensive overview of legacy education in Bangladesh which might reflect the state of the art in many countries of the developing world.

3. Education in ICT age

With the advent of ICT, education is becoming increasingly attached to internet based knowledge sharing platforms. Several platforms are available now to gain knowledge. Anyone now have the opportunity to know anything with the help of internet. ICT tools for education have been developed to assist legacy education for effective learning. Different educational methods including pedagogy, blended learning etc. are developed and tested for learners. Among

these MOOC (Massive Open Online Courses) is the most popular platform to provide teaching learning worldwide.

A MOOC is an online course with the option of free and open registration, a publicly-shared curriculum, and open-ended outcomes, (McAuley, et al.,(2010)). MOOC helps learners to study at their own pace and meet the learning goals with flexible lecture video & online assessment. The term came into being in 2008, though versions of very large open online courses were in existence before that time (McAuley, et al., 2010). MOOCs are provided in both free of charge & with tuition fees format. Current many professionals are taking MOOCs for their professional development. Students are getting interested in MOOCs but to access MOOCs they need good internet connection with high bandwidth. MOOC has the potential to reach the unreached in every part of the world.

We argue that the problem in MOOC is same quite similar to the legacy education, where students lost motivation when they got stuck in a point of the lecture. As there is no instant guidance to solve the problem, they either skip the problem or stop watching the lecture. Again the assessment is most of the time MCQ based where student has limited opportunity to discuss on their questions. More on MOOCs can be found at McAuley, A., Stewart, B., Siemens, G., & Cormier, D.(2010).

MOOC education is offered via several online platform like Coursera, Udemy, MIT Open Courseware etc. Till now thousands of courses in different area are available in those platforms. Use of ICT and multimedia in education makes it interesting and fruitful, (Kazi et al., 2012). From our experience, we have found that students' feedback or learning progress is not monitored or mentored as per expectation. Real time support from an expert is not always possible and thus self motivation and concentration is highly required in this form of education. On the other hand, participants in this form of education will need PC/Mobile devices with good internet connection for getting video lessons which is challenging in developing countries like Bangladesh as internet is not free of charge. Again not every student has PC at their home. Mobile devices are more popular but students are not motivated to buy internet data package for getting online lessons. One of the reason is no initiative has been taken to motivate students from school to explore MOOC platform as private tuition is a fact Bangladesh. Teachers fear that if MOOC is available then student may not depend on teachers and gradually they may earn less from private tuition. Face to face discussion or guidance from an expert when needed is much appreciated by the students. MOOC or legacy education is independently cannot address every problem for solving effective teaching learning issue.

4. Just in Time Education (JINTE)

Our proposed system is a just-in-time guidance system to any question asked by a student from an expert. The platform allows students to get just in time guidance from a relevant crowd sourced subject teacher with instant customized care, Fig-1. Students can access subject-chapter wise Q&A section and learn from content available & previous discussions. Students simply can call to our platform for getting answers from a teacher directly. Direct call can be useful for any students, particularly students in rural areas and students with no Smartphone.

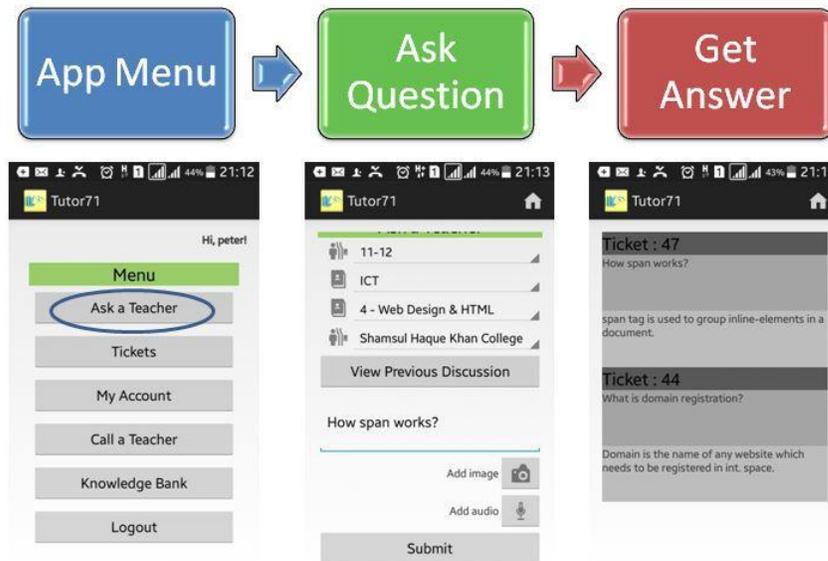


Fig 1. Just in time guidance system

Teachers participating in this platform will have the opportunity to reach students countrywide and get experience by providing answers to different questions. Most participating teachers will be invited to join “Subject wise Expert Panel Teacher” to develop the knowledge base with an agreement. Schools can participate in this platform as a School Partner which will be benefited for them by getting customized solutions for their institution and school management system. Teachers and students of a School Partner institution can have the option to customize and prioritize the service in their own group.

The student would require a computing device such as a mobile phone, tab or PC with or without internet connection. For no internet connection students would require to access our system via Facebook Free Basics Platform as our service is accepted in their platform. When a student study after class lecture or during class if he has any question that is not addressed by the teacher, he can ask the question anytime in our platform and available crowd sourced relevant subject teacher will answer the question. The immediate feedback to the learner is highly motivating (Yousuf et al., 2006). Each question asked by the student is save in our database and from there we will generate the knowledge base for students to get prior knowledge if required. Teacher will be able to check the understanding level of the student from previous participation data analysis of that student before answer his question. Our system can be used in a closed group class where student can ask question to their teacher that was not addressed during class hour.

5. Example Scenario

A student can use the system anytime he needs to get answer of his question. For example, when a student is studying alone at home and no one is there to help him, he can use this system to get guidance. If a student feels that he is not getting the concept right he can use his mobile and login to our system. After that he can ask question to our experts available at that time and get quick response from his teacher. Student can also get help from knowledge base to learn from previous discussion. Students with no internet access can also get his problem solved

by calling directly to just in time education platform and discuss to an expert regarding his question. Direct calling is useful for students living in rural area. The scenario is described in a diagram below,

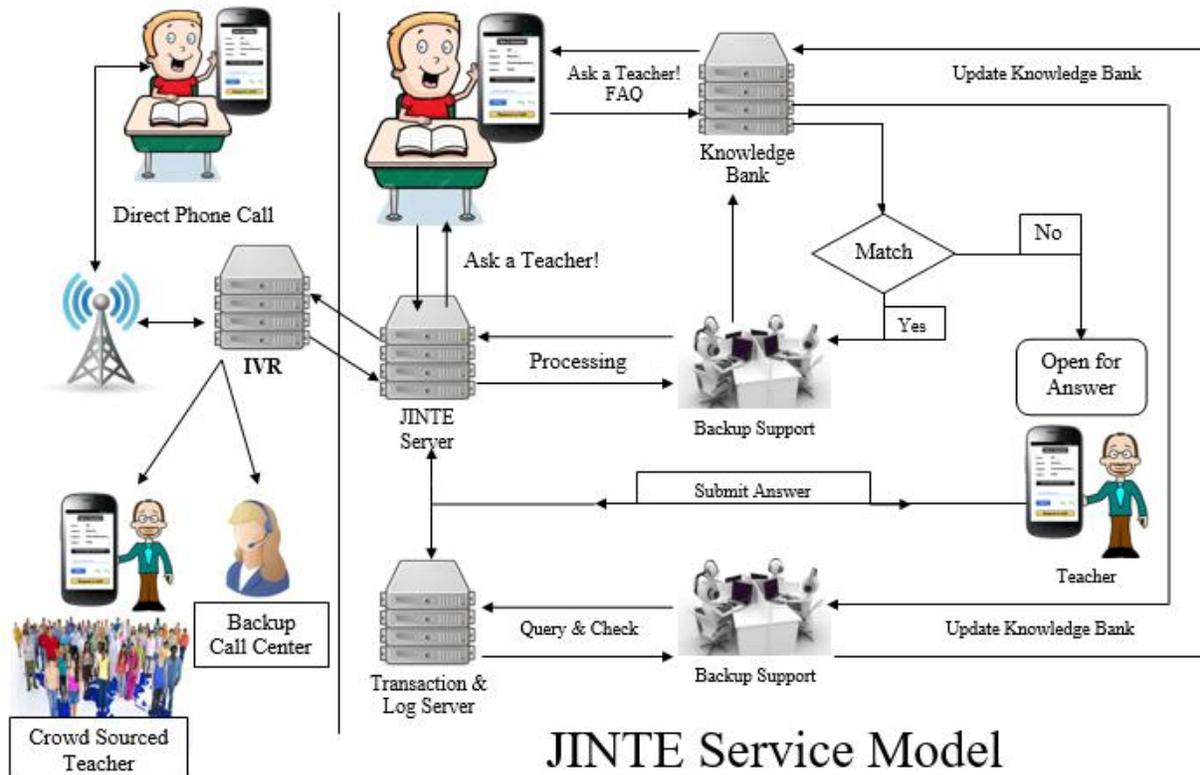


Fig 2. Just-in-time system diagram

6. Methodology & Data Source

This paper illustrates how the proposed system can help students to get guidance just in time from an expert. In the usual physical class where the participants can see the teacher, they can ask any questions to get better understanding on their lesson. After the class, when student face problem then to ask his teacher about that they would need the Mobile or PC that would directly interface with a central database server and send the question asked to the teacher and when any teacher provide answer then show it to student. The system will also provide knowledge bank for better understanding on the topic before asking question. Knowledge bank will contain previous questions asked by students with input from expert teacher panel and more content to provide overall concept about that topic. This content will include audio, video, image, text etc. To answer a question by any expert, he would get an analysis of student on learning pattern, behavior, performance, interactivity etc. so that the expert will get a prior idea on the answer style that will be helpful for that student to understand. After the student get the guidance from the expert both student & expert will have the option to rate the question & answer with request for more explanation. This will help both parties to improve their teaching learning performance and show how their skills are growing. We had tested our system with 2 schools in Dhaka city

with 100 students to get data and validate our system from analyzing those data. Appendix A has a sample questionnaire used for the experiments.

7. Testing of Proposed System (Case studies of two representative schools)

The on the spot guidance system over mobile phone or PC with instant feedback from an expert was lab tested in Shamsul Haque Khan School & College, Demra, Dhaka & Dr. Mahbubur Rahman Mollah College, Jatrabari, Dhaka with 100 students of class XI & XII using their regular mobile phone including both featured phone & smartphone. A t-test was used to compare the learning in the just-in-time guidance to a regular situation with no guidance instantly. In all cases, after the first couple of classes almost the entire class started participating by asking questions to our system. The feedback from students and teachers helped a lot to modify and improve the developed software system.

Table 1. Target group summary of Shamsul Haque Khan School & College

Target Class	XI & XII
Total Students	1500
Gender	Female Only
Sample group	50
Sample Course	Physics
Total Class Conducted	5
Total Questions Received	93
Quiz Performance	Better than non participating students

Shamsul Haque Khan School & College (SHKSC), Demra, Dhaka, (Web: www.shkscbd.info):

Students of Shamsul Haque Khan School are more studious than many other schools. It was decided to check the participation and quiz performance of such a student. The system was used to solve problem from the Physics course which is compulsory for all students for Class XI & XII students of Shamsul Haque Khan School & College. The number of students participated was 50 and all of them are female students. A total of 5 classes were conducted and average question asked after each class was 18.6. The percentage of average question asked was 37.2%. It was noticed that most of the less performing students were participated and asking questions in our system. The quality of questions asked by a student were increased after each participation. From empirical data given by teachers at Shamsul Haque Khan School & College, the maximum

number of students that generally respond to a question in a face-to-face class of about 30 is 5. So large number of students are not participating due to shy factor or not following the class. It was noticed that students who asked question to our system performed better in weekly quizzes than non-participating students. The feedback from the students & teacher helped our system to improve the user experience.

Table 2. Target group summary of Dr. Mahbubur Rahman Mollah College

Target Class	XI & XII
Total Students	3000
Gender	Both Male & Female
Sample group	50
Sample Course	Information & Communication Technology (ICT)
Total Class Conducted	8
Total Questions Received	128
Quiz Performance	Improve performance by using JINTE

Dr. Mahbubur Rahman Mollah College (DMRC), Jatrabari, Dhaka, (Web: www.dmrcbd.info):

The first improved version of JINTE is then tested at Dr. Mahbubur Rahman Mollah College where most of the students are average performing students compare to the previous school. The number of students participated was 50 of class XI & XII where 25 students were male and 25 students were female. The system was used for Information & Communication Technology (ICT) course for science group to answer any questions asked by the students after class when they study alone at home. A total of 8 classes were conducted and average question asked after each class was 16. The percentage of average question asked was 32%. It was noticed that most of the students were curious for participating and asking questions in our system. But as internet data is not available at their home, they could not ask question in our platform. This also indicates that people need a purpose to use internet not they buy it to create one. The quality of questions asked by a single student was increased after each participation. The students who asked questions regularly were performed well in quiz exam and the random questions also helped teacher to tailor his lecture for better learning in the class.

8. Result Analysis & Discussion

At Dr. Mahabubur Rahman Mollah College, total of 8 classes were taken where we collected data to be used in the T-test. The pre-test and post-test were taken for 50 selected students to validate their merit similarities with 8 classes. After using our proposed system with class lecture, post-test was again taken in the form of quiz to compare the results achieved in both learning methods (legacy education & legacy education with JINTE). We have divided 50 students in two groups. Group-1 has the students who used JINTE after class to ask questions when they faced difficulties. Group-2 has the students who did not ask any questions in JINTE after class. We have tried to figure out the quiz performance of these two groups to find out if JINTE can enhance their learning and helped teacher to find the gaps in his lecture delivery.

Table 3. Pre-test & Post-test summary

Pre-Test	Participants	Group-1 & Group-2
	Course	Information & Communication Technology (ICT)
	Method of testing	Verbal Questions
	Pre-concept on topic	Minimum for both Groups. We have found merit similarities between two groups.
Post Test	Participants	Group-1 & Group-2
	Course	Information & Communication Technology (ICT)
	Method of testing	Quiz Total 10 Questions asked Highest 10 out of 10 Lowest 3 out of 10 Average 6.5 out of 10
	Post-concept on topic	Better for Group-1 than Group-2
	Quiz Performance	Improved for Group-1 Than Group-2

T-test analysis for Quiz performance of Group-1 & Group-2 is as follows,

Quiz marks for Group-1 out of 10: {9, 7, 8, 6, 5, 10, 8.5, 9, 9, 10, 6, 8, 7.5, 10, 9.5, 5, 6, 5.5, 6.5, 9, 10, 5, 7.5, 8, 10}

Quiz marks for Group-2 out of 10:

{7, 3, 8, 4, 5, 7.5, 4, 8, 5.5, 4, 6, 9, 5, 5.5, 4.5, 10, 6.5, 7.5, 5.5, 9, 4, 3, 4, 9, 3}

Table 4. Unpaired T-test result of JINTE

P value and statistical significance:

The two-tailed P value equals 0.001

By conventional criteria, this difference is considered to be highly statistically significant.

Confidence interval:

The mean of Group-1 minus Group-2 equals 1.900

95% confidence interval of this difference: From 0.790 to 3.010

Intermediate values used in calculations:

$t = 3.4404$

$df = 48$

standard error of difference = 0.552

Data Summary:

Group	Group-1	Group-2
Mean	7.8	5.9
SD	1.762	2.126
SEM	0.352	0.425
N	25	25

9. Usability of JINTE

Quantifying users' performance is a dominant theme in usability testing studies (Nielsen, J. 2002). The usability of the system can be measured by users' performance and satisfaction through interview data. Out of 50 participants 80% of the participants had satisfied with JINTE. Only 20% participants are not satisfied due to lack of internet usage knowledge. Also they don't have their own mobile phone. So they had to borrow phone from parents and tried to use JINTE. We have found the level of ease increased by 40% when participants asked questions more than

once. During interview session, participants were very positive to use JINTE and said they used such system for the first time to guide them when study alone. After using the system, we have asked them ‘Do you agree mobile device is a good medium for learning?’ About 90% of the participants agreed that mobile device is a good medium for learning.

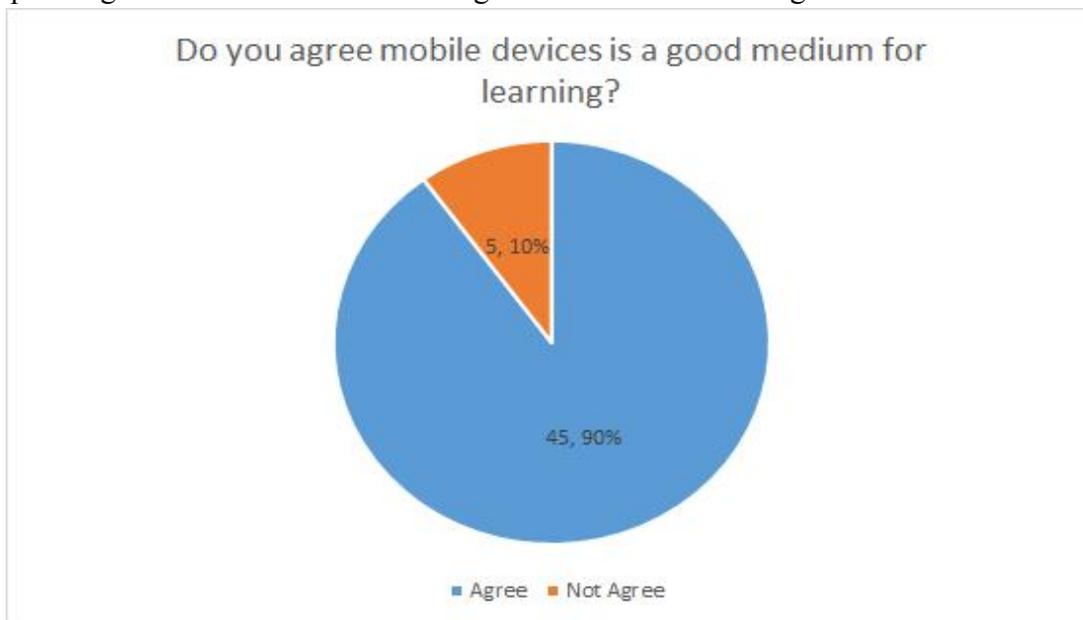


Fig 3. Student's response on mobile as learning medium

Most participants’ told that due to availability and quick access, mobile devices is the best medium to prove JINTE especially in rural areas of Bangladesh. 80% of the participants found JINTE user friendly and confirmed that JINTE had increased their learning (refer to the T-test result). 90% of participants believed that it is convenient to use JINTE and 10% of the participants found it difficult as it requires internet on their phone.

10. Feasibility of JINTE

The development of a country highly depends on educated youth. Bangladesh has 50% of population under 25 years of age, <http://energybangla.com/country-to-be-digital-with-youths-innovation-nasrul/>. If we can make this large youth group educated then they can contribute to the economic development of Bangladesh. The secondary school dropout rate in Bangladesh is significantly high. Currently it is 46.70% for male & female in secondary school, (BANBEIS dropout rate, 2012). The reasons for dropout are, relationship between child and its relationship within the household, cost of schooling, distance to school, low income of parent, parents education, early marriage etc. (Ricardo, et al., 2010) & & (BANBEIS Secondary School Dropout Survey, 2012). Among these reasons we noticed that no discussion has been made for motivation of students towards learning. Our findings shows that students are motivated when they study alone but when they faced problem on a topic and found no one to help him to solve that he loses motivation and stop studying. If guidance can be provided at that time instantly then they might find their lessons interesting and go ahead. According to the information of

Bangladesh Bureau of Educational Information & Statistics (BANBEIS, <http://banbeis.gov.bd>) current education statistics are,

Table 5. Year wise educational information (Source: Banbeis, 2012)

Year/parameter	2009	2010	2011	2012	2013	2014
Total High school	19083	19040	19070	19208	19602	19684
Enrolment Rate	17018112	15770000	15768000	15964494	16183208	16404918
Teacher Student Ratio	N/A	1:34	1:30	1:36	1:37	1:39
Dropout rate	55.31	55.26	53.28	44.65	43.18	41.94%
Assistant Teacher (Computer)	8290	8921	9828	10225	10610	11749
Assistant Teacher (Mathematics and General Science)	21390	22118	23048	22078	21086	22939
Computer Teacher(only govt school)	N/A	36	12	62	12	8
Computer Teacher(non govt school)	N/A	3460	9816	10163	10610	14711
% of schools with Computer facilities	N/A	59.21	65.06	70.3	78.77	80.35
% of schools with Internet Connection	N/A	18.18	29.73	45.7	63.37	69.11
% of school with electricity connection	N/A	71.71	75.98	77	81.38	83.17
% of school having multimedia facility	0	0	0	10.1	57.92	66.22
% of School having solar system	0	0	0	0	7.71	7.52

The dropout rate is decreasing yearly but still it is not satisfactory. BANBEIS has conducted secondary school dropout survey and from this survey some recommendation has made for reducing dropout rate among which free education for poor students, flexible & distance learning, direct interventions for identified dropout etc. are important, (BANBEIS Secondary School Dropout Survey, 2012). Only 5.8% of the primary school is equipped with computer, projector and laptop where 94.2% schools are out of these facilities, Primary School IT Facility (2016). ICT is also used for developing supplementary content for children. Save the Children has developed supplementary teaching learning content based on the national

curriculum and it is uploaded at www.dpe.gov.bd for easy access by teacher & student by the government, (ICT for Learning, 2016). Also training for teacher led content development initiative has been taken to empower teachers to develop their skills in ICT area and use ICT in their daily class lectures for better learning, (ICT for Learning, 2016). Government is very positive to develop the education section by introducing ICT interventions. Participation from general public and private sector can foster this development and increase awareness to use ICT in all situation to solve any problem.

Bangladesh has reached 130.881 million mobile phone subscribers as of March, 2016, [<http://www.btrc.gov.bd/content/mobile-phone-subscribers-bangladesh-march-2016>]. It indicates the wide coverage of mobile phone access in the country. Currently the mobile network coverage is available countrywide.

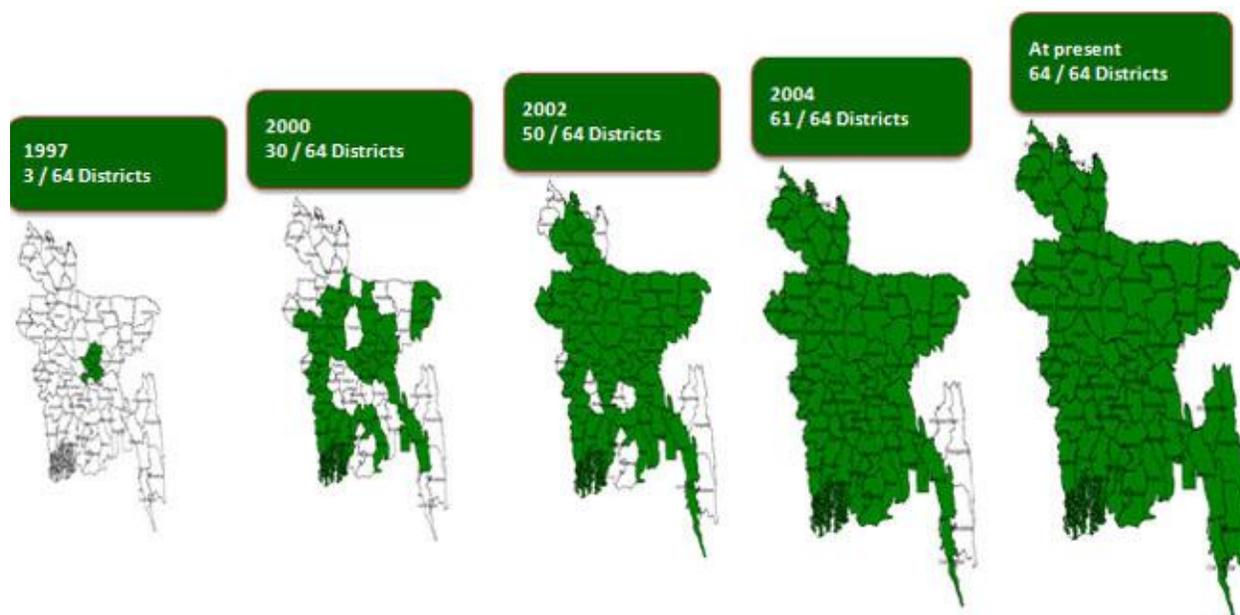


Fig 4. Mobile network coverage in Bangladesh, [source: http://www.amtob.org.bd/index.php/home/industry_statistics]

Thus any intervention for education using mobile devices will be very helpful to reach each person. Our proposed JINTE system will be an option to get help for students when they need someone to help them on their lessons. It is available 24 hours and any student can study at his own pace with the help of JINTE. We have tested JINTE in a limited scale at 2 schools and current working with 5 other schools for pilot. We believe JINTE can be helpful to motivate students and reduce the dropout rate through providing access to just in time teaching learning.

11. Conclusion and Policy Relevance

This paper proposes a novel model for ICT based education that caters to the need of the student as and when they require. Students as they self study may stumble into learning challenges that might require external aid. In the developing country, most families do not have educated parents, lack economic power to afford external educational aid except for free –

schools. In order to retain the motivation of the student a low cost ICT solution via mobile messaging system to provide just in time educational help may work wonders. The proposed ICT tool, JINTE guidance system for students may help retain the students 'motivation towards self-study. This can be a supplementary educational platform along with MOOC and the legacy educational system. Our experiments show positive results in terms of the effectiveness of the system. At the same time , the educators may learn the learning issues related to the topics they teach by the data acquired via monitoring the patterns of the questions asked by the students. The platform can be used as an educational data collection tool countrywide and detail analysis and processing will make these data very useful for policy maker to initiate long term sustainable plan for the educational material development of the country. The data gathered, may also help to plan on the ways to engage students from remote places in the learning process. Countries that want to use ICT at effective educational tool, may consider these idea of delivering educational guidance as and when required. However, the mode of use of the data and how they might help is part of our future research plan.

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Appendix A
Sample Question

Pre-test Questionnaire (Verbal)

1. What do you know about Web Design?
2. What is HTML?
3. Where do we use HTML?
4. What can we do with HTML?
5. Why web design is important?

Post-test Questionnaire (Written, Marks-10)

1. Describe why web design is important?
2. Write in your own words about HTML?
3. What is the basic structure of HTML?
4. What is HTML tag? Give example of 3 HTML tag with description.
5. Write HTML code to create a form with two labels & text fields and one submit button.