Synchronous Adaptive Mobile Learning

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Abstract

To get the right education from the right people is the basic right of the learner/student. Due to lack of teachers or geographical limitations of the teachers, computers have been used as a medium in education. Starting from the use of Information and Communication Technologies (ICT), smart class to flipped classroom and flipped learning, many theories have been tried by many people. In Gujarat, more than 2000 schools had installed smart class technology till the year 2009. Blended Learning or Flipped Classroom model is a learning approach that enables the blending of technology based (self-paced student) learning for the core concept, followed by in class doubt solving, group discussion, etc. The teacher acts as a guide / coordinator, unlike traditional learning environments, where all forms of teaching takes place in a crowded group. The teacher's involvement in showing course video materials to the students is very important and that has to be implemented for the whole class and is only applicable for certain courses; teachers have to create their own videos; and content should be only in video format. It is therefore important for teachers who plan to implement this instructional approach to be aware of its positive aspects, and potential negative misunderstandings should be understood in order for them to be avoided. The students should be continuously motivated for learning. And that's how adaptive learning came into my mind. The content delivery system for adaptive learning is very important. Synchronous Adaptive Learning aims to establish adaptive learning practices in the space of real-life teaching environment (classroom, webinar, online group teaching, etc.). This innovation allows group sentiment analysis to happen in real-time; teacher to student (s), student(s) to student(s) and student(s) to system engagement occurs through learning. All the streaming data are analyzed and then feedback is generated for teachers to align delivery, activity, assessment, and/or support immediately. The best part of this innovation is the delivery method and analytic solution to work on 2G network covering need of emerging nations.

Keywords: Blended e-Learning, ICT in school, Flipped Learning, Adaptive Learning

Introduction

In Traditional Face –to-Face Learning (TF2FL), there is a lack of the geographical reach of the teacher. After being taught in class, there is a possibility that the students might face difficulty in revising the portion. If the student remains absent in a class, there is no chance that the student is taught the same thing again by the teacher. The use of ICT in the classroom was also started in the whole state of Gujarat as well as in other parts of INDIA since 2006 but many school principals, teachers and students were not happy with it. We started the offline delivery model in Kaparara village and experienced the difficulties faced by the students, which in turn inspired us to think again of something better. Then we came up with the new project of Blended Learning Program at Bilimora. After observing for almost 18 months, we came to know at what different levels, should we integrate the traditional teaching and technology, and even there, after observing problems, we came up with the adaptive learning.

Regular Classroom Teaching

My mother and my grandfather were teachers in a school in a small village near Ahmedabad. Since my schooldays, I have been passionate about teaching. After obtaining my education degree, I joined a school in the year 1993. Since then, I have been teaching Mathematics to students studying in grades XI and XII. Being in the educational field as a teacher, I realized many things and tried to come out of the traditional system.

I used to constantly think and implement new methods in education, but I always felt as if somewhere something is lacking. One thing that I frequently surveyed was that the teachers used to face lots of distractions in the classroom on a daily basis. There were times when they would have to deal with uninterested students or the absence of parents' support. Younger students often show an ignoring and neglecting behavior as they are not yet mature enough to understand the importance of education. Such uninterested and demotivated students cause frustration in teachers and are a real challenge to them. Technology has become an essential part of education, so classrooms today are equipped with computers. Computers are provided to students to avail help and knowledge online and work on their assignments. But again, the problem faced by teachers here is to monitor the students strictly while working in the computer lab.

Busy lifestyle and lack of interest in traditional learning methods among students pose many challenges for the current generation of teachers. Such students find it difficult to concentrate on the lecture and appear bored. Lethargy and exhaustion may be caused by many factors, one of which is doing a job in parallel with studies. To solve this problem, teachers need to talk to students and their parents as well.

Teachers have a great responsibility and to meet this responsibility, they need help and support. Parents and the school administration should communicate properly with teachers for the betterment of students and class discipline problems. But geographically, teacher's reach is minimal and there are economic constraints as well. To get the knowledge from the right people is the basic right of the learner or student.

Being a teacher in this field since 24 years, I am continually finding new ways to fulfill these answers.

Use of ICT in Schools

The rapid developments in technology and the related cost reduction has resulted in a structural change in society. We all know how helpful it is to remember something that is taught visually to students rather than the one that is read through just orally or pages after pages. Just imagine, how beneficial would it be for students to understand a chapter visually

in class. The concept of smart class education is indeed a blessing to the students of the 21st Century. In a social framework surrounded by technology, it is inevitable for the educational environment to be affected by the same. While life goes on during a time of such striking change, it is not possible in the classroom to prepare the students for the real life using traditional approaches. Educational environments should help students to become independent individuals, and to be able to apply what they learned to real life. Thus, classrooms should be integrated with developing technologies and should be used efficiently. The Information and Communication Technologies (ICT) revolution is acknowledged as the next great thing in India's primary and secondary education sector. ICT education companies — led by tech-savvy entrepreneurs — are swamping the market with teaching-learning equipment such as interactive display boards, laptops, curriculum-mapped digital content, school management, teaching and assessment software, Science, Mathematics and language labs and numerous other products and services.

The marketplace for ICT in education in India was estimated at Rs. 285,000 crore ($50 billion) in June 2012 and is expected to grow to Rs. 570,000 crore ($100 billion) by 2014-15. In India, 52.75 per cent of schools do not have electricity, 12 per cent are single-teacher schools and 42.75 per cent do not have libraries.

And hence from 2006 to 2009, many educational content provider companies came into the picture. And they started to approach to different schools of Gujarat and even India. In 2006, I can say it was the "SMART CLASS ERA" in Gujarat. Every school management wanted to install the smart class system in their schools and at that time schools took pride in having the smart class technology. I even signed a contract with Educomp for my school in the year 2011.

Following are the names of some of the nationwide companies that supply the smart class technology to schools and educational institutes.

Educational Company	Entered in the market	2011		2014	
		No. of Schools in India	No. of Schools in Gujarat	No. of Schools in India	No. of Schools in Gujarat
Edurite	2004	500	80	400	80-100
Educomp	2006	10500	1200	6730	300-350
Mexus	2009	4400	600	1200	Closed
ExtraMarks	2007	500	125	600	150-175
TeachNext	2010	400	300	1100	230-250
HCL	2012	Data Unavailable	Data Unavailable	Closed	Closed
TATA	2010	Data Unavailable	Data Unavailable	Closed	Closed
EducationKranti	2007	120	0	Closed	Closed

A big hype was created in the society and everyone felt that the absence of smart class will lead to the students being deprived of quality education. Prominent digital content provider, Educomp Solutions' roller coaster ride over the past few years seeing growth followed by huge slump through 2012 can be an eye-opener to educational institutions as well as corporate across the country. The company that once created the hype around its Smart Classes and other smart moneymaking opportunities in school education, is now making headlines – mostly for the wrong reasons. Even the Government of Gujarat tried to

tie-up with these companies. In Gujarat, there are 3500 schools where students are studying from grade VIII to grade X.

Educomp is a clear example of a company that tried its hands in too many things and lost focus. There was a lack of strategy leading to its fall, observes an industry expert keeping her identity anonymous. This was evident from the fact that the company's net profit margin has fallen 61% since 2009 and the net cash generated by its operations has declined significantly in 3-4 years and most importantly, its overall liabilities in 2012 were over twice its revenues. According to a report that appeared in Forbes, the company's market capitalization has fallen from Rs 7,000 Crore in November 2009 to just Rs. 771 Crore as of March 2013. Educomp ventured into the business of Smart Class range of digital classroom aids that allowed school teachers to use interactive multimedia content to supplement the standard textbook-and-blackboard approach. Smart Class concepts mushroomed in a few years and by 2012, Educomp had in its kitty nearly 7000 schools from less than 100 schools in 2006. Schools affiliated to the CBSE, ICSE, and the State boards passing on lakhs of rupees to avail online learning content solutions alleged that the company failed to deliver its promises. Govt. Of Gujarat tried to tie-up multimedia content development project for 3,500 schools. Educomp's ICT division, Edureach, has bagged a multimedia content development project from the Government of Gujarat. Educomp has bagged a similar project from the Government of Assam also. In this regard, the Commissioner of Schools, Education Department, Government of Gujarat has awarded a letter of intent (LOI) to Educomp Solutions Ltd.

Under the project, the company will now develop and install a 2D/3D based multimedia content across all schools of Gujarat and development of web portal for learning management. The project has been for five years, including updating of content as per the change of state syllabus. The scope includes development of multimedia learning content in Gujarati medium for grades VIII to X covering core subjects including English, Mathematics, Science and Social Studies in around 265 learning areas, and development and conversion of content in MS Windows and Open Source platform. Spanning across 3,500 schools, the project also entails the development of a web portal with interface for using the multimedia based learning content as well as upgradation of the developed learning content with the change of syllabus. According to Educomp, the education solutions provider will also build up the capacity of school teachers on the usage of ICT application to be developed for seamless transaction of the classroom teaching learning process.

In Assam, Educomp has signed an agreement with "Sarva Siksha Abhiyan" Mission, Government of Assam for providing computer aided learning solutions in 2199 middle schools of the state. Educomp will develop, supply and install multimedia based educational content for computer based education in Science, Mathematics and English in three vernacular languages-Assamese, Bodo and Bengali.

The multimedia learning contents will be developed on 60 learning areas identified for grades VI and VII. Educomp will also build up the capacity of school teachers on usage of the multimedia learning content and its transaction during the classroom transaction process. But before introducing the smart class, the school needs to be fully equipped with the so called smart teachers who are aware of the changing trends. Even the companies who delivered the content were unable to train the teachers in the SMART USE of the SMART CLASS and thereby it failed.

I started to use ICT in my school Divyapath from the year June-2011. Having been in the educational field since last 24 years, many times I have observed that students find difficulties while revising the portion at home, which was taught at school. After learning in a regular school classroom, they become helpless if they have any doubts. They will have to

wait one or two days till the school teacher is available and they get to meet them to solve their doubts. As a solution of this, I thought what if they are given a specific system for revision where they are free to use it anytime and anywhere. As a result of it, the concept of Blended Learning came to my mind two years ago.

I introduced the Educomp Smart Class system in my school in ten classrooms with the thought to convert all the classrooms (whole school) into this system. But I was not happy with the content as well the delivery structure. Initially our whole staff, including parents and students were happy to have the smart class system in school. We changed the timetable and students were being taught through Smart Class including regular classroom teaching.
Here is the data mentioned, taken from the year 2012 by Divyapath School.

Grade	Total number of Students (2012)	Regular Classroom teaching (Yearly Hours)	Teaching through Smart Class (Yearly Hours)	Result (Results noted monthly and then here is the average results)
Grade-I	98	650	100	Unsatisfactory
Grade-II	110	650	100	Unsatisfactory
Grade-III	105	650	100	Unsatisfactory
Grade-IV	102	650	100	Unsatisfactory
Grade-V	88	650	100	Unsatisfactory
Grade-VI	90	640	200	Unsatisfactory
Grade-VII	85	640	200	Unsatisfactory
Grade-VIII	80	540	300	Average
Grade-IX	106	540	300	Satisfactory
Grade-X	110	540	300	Average
Grade-XI	280	540	300	Average
Grade-XII	190	540	300	Average
Total number of Students	**1444**	Total no. of Hours	2400	

The overall performance of smart class was average in my school. The students and teachers had been given a questionnaire and feedback form and that became the turning point of my research. In Gujarat, almost 1400 schools have adopted Educomp/Edurite/HCL/TeachNext/TATA/ExtraMarks etc. And in India, there are many schools that are in search for good options in the future for their kids, the future citizens. In addition, students stress that the technological resources provided in classrooms are often insufficient and they expect to utilize more technologies in learning activities today (OECD, 2012). Prensky (2011) named these students as digital natives.

Offline Delivery Model

After the failure in my school, I thought in a different direction. If a local teacher teaches the student in local language in the same accent, then it will become easier for the student to understand and to remember. So with the help of the technology, we recorded video sessions of experts' teachers from grade 9 to grade 12. It was not an easy job for us to explain the teachers our concept, and because many experts, experienced and aged teachers are not tech-savvy, we faced difficulties to engage them for this type of content creation.

We started with sixty two teachers and out of them, forty three teachers completed the whole task. Teachers' continuous motivation was very important to finish the work. After the video recording, our IT team, which included thirty five members, edited 5500 hours of data and converted to easy viewable mode and prepared the DVDs. We had selected market segments for the project. Marketing team members started to visit the schools in different parts of Gujarat.

AREA	Cities/Villages	SCHOOLS	Number of students contacted	Number of students who had used DVD for more than 8 months (Actual Users)
Urban Area	16	52	3500	225
Rural Area	62	127	8500	480
Total Number of Students contacted at 8 months			12000	

The management of distributing DVDs became a tedious job for all of us. Foremost of all, the school students were to be explained this concept and then the students' as well their parents' motivation was very much needed and important for swallowing this.

Truly saying, we didn't get the best experience. Teachers, principals and students liked our content a lot, but in some way we were unable to change over into actual users. And then, in a small village named KAPARARA, we tried our pilot for 1 year. It was a government tribal school where there were no Mathematics and Science teachers and the students studied through our DVDs and we received serious answers. **Moreover, I felt that people were not fully satisfied with this...**

Again, this led me to believe something more innovative: Blended Learning.

Blended Learning Model

Today's generation is known as digital natives using technology; spend most of their time with these puppets, and deliver access to totally different procedures in order to gain and process information, compared to former generations. To raise students, who have different qualifications than the students of previous generations, as members of a qualified workforce, the current educational technologies should be utilized efficiently. When the progress in education technologies, the need for a qualified workforce as a requirement of the information society, and the learning preferences of digital natives are considered, the needs for new learning approaches become inevitable. Flipped learning is an alternative learning approach that could offer solutions to these very problems. Flipped learning provides a different solution to teaching-learning processes, which are usually realized through a one-way communication from the teacher to the student and under the influence of behaviorist

theory, as a learning approach that supports the constructivist theory. Since its origin, it has drawn the attention of educationalists and its role has become more and more widespread.

Dutton and Loader (2002) mentioned that the institutional providers of Traditional Face To Face Learning (TF2FL) classroom education should adapt to the virtual learning methods in order to survive in today's modern education industry. Blended Learning (from here on BL) is considered to be one of the modern virtual learning methods and is emerging as the new paradigm of alternative education. BL is a mixing of practical learning and TF2FL methods, as it brings the advantages of both learning worlds. Throughout the virtual learning literature, BL is proven to be one of the best learning methods, as it improves learners' motivation internally and externally. Moreover, several studies from various domains have tried to explore the BL in motivating learners in higher education (Chen & Jang, 2010). There is a need to pay full attention to identifying the exact opportunities and challenges of BL. Blended Learning combines online delivery of educational content with the best interaction and live instruction to personalize learning which also allows thoughtful reflection.

Two Models of Blended Learning

Pull / Self-paced Learning

This model provides structured & indexed digital learning material(s) delivered through a web / mobile portal in a planned manner. The objective is to mostly provide the learners with supplementary educational material to be consumed in their own time and pace.

The key advantage of this model is access and availability of the quality resources, anytime, anywhere learning opportunity, and self-paced delivery.

The known issues with respect to learning in this model include motivation, cohesiveness, and same content and delivery structure applied to all. We have implemented a few elements to minimize these issues for example leader board to motivate / reward learners, planned / hierarchical structure to build cohesiveness, and adaptive learning activity integration to serve different learner's need.

Technology assisted Instructional based Learning

Educational content tailored for the classroom/group based delivery is offered. The objective is to complement classroom learning with lecture / content from the subject experts weaved conveniently into curriculum learning delivered by the local teacher.

The advantage of this model is to help plug key competency / resource gap at regional level. The content is mixed with classroom delivery and activities in order to deliver holistic learning to students.

**Synchronous Adaptive Mobile Learning**

Project Vision

Enable personalized education to reach masses through mobile / connected devices. Enable top educationist (senior expert teachers) to conduct live teaching sessions for masses helping education to reach last mile.

The Project Objectives

The objective of this application is to make live teaching available to the students on their android mobile / tablet at 2G speed. TruTeach shall use predictive presentation technology to enable "very low bandwidth" delivery possible. TruTeach is a bi-directional delivery platform allowing access of data transfer at both the end.

Illustrations and Use:

1. A teacher using whiteboard only:

Student -1　　　　　　Student -2　　　　　　Student -3
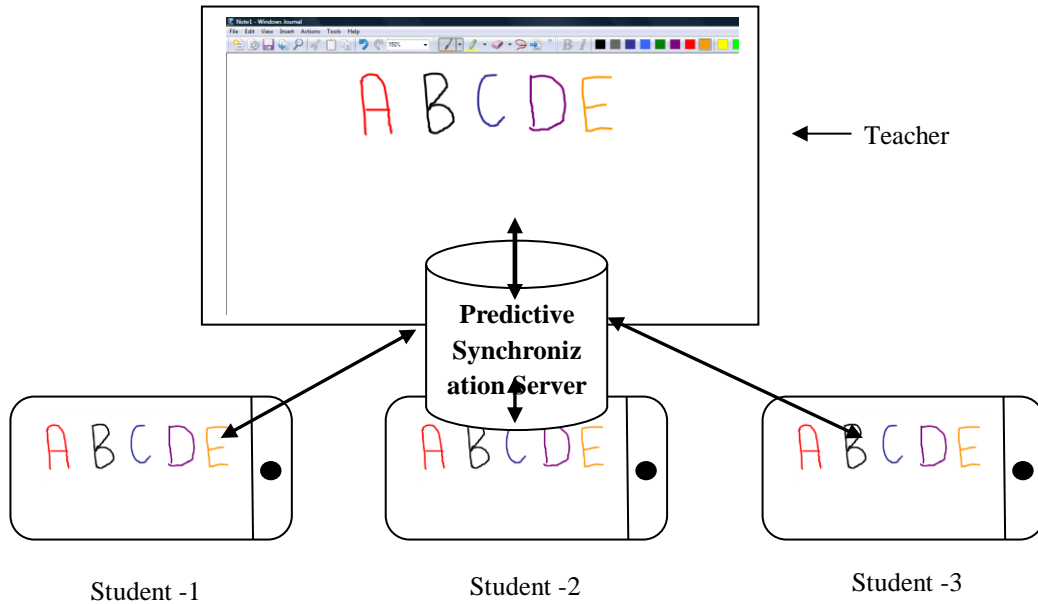
2. Scenario 2 can enable teachers using presentation material limited to PPT / PDF / Images and using annotation on it.

Technology Overview:

The TruTeach system consists of scalable Model-View-Controller framework enabling Author / Students to engage in adaptive learning experience in real-time.
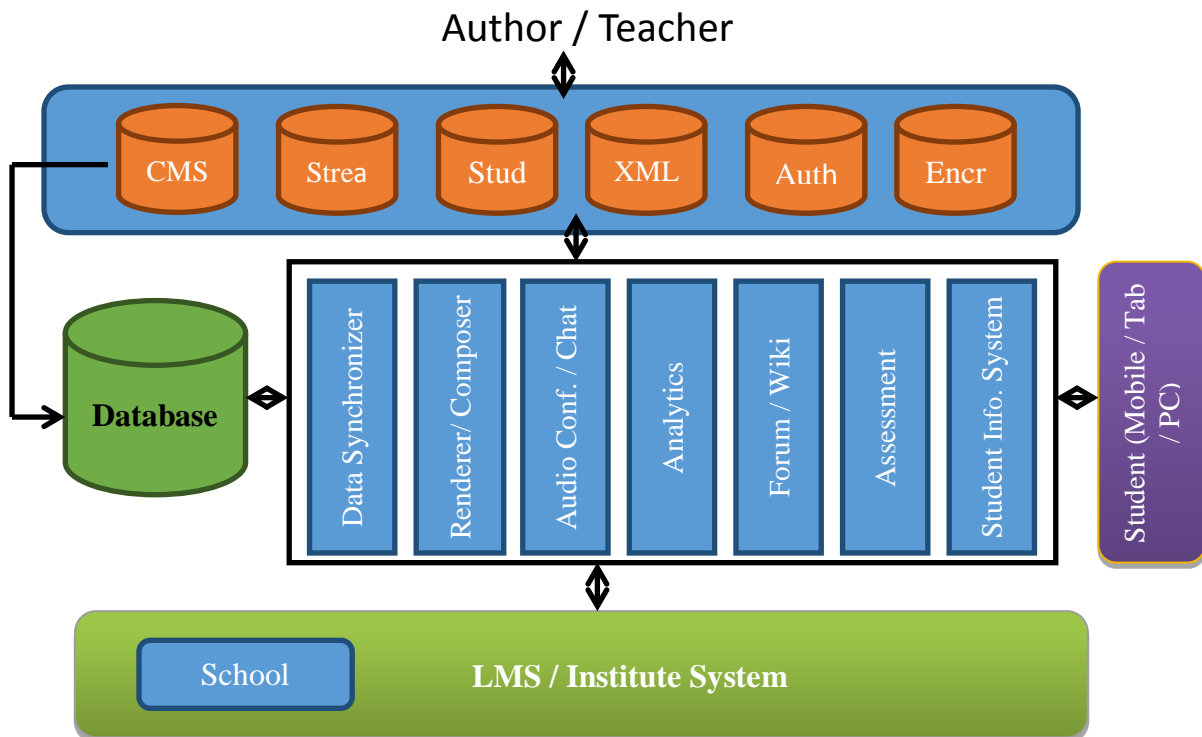
The key component of the system includes:
- CMS: Content management system. Content access / storage / topology management / indexing.
- Streamer enables real-time and offline exchange of the author's teaching (including all forms of multimedia and other data).
- Studio: Content Creation and Delivery System, the subsystem include planner and presentation modules.
- XML / Doc Tagger: All author's data are packaged and tagged for reusability, re-purposing, and analytics.
- Authentication Module: Manage credentials, log-in management, single sign on feature, etc.
- Encryption: All data are encrypted with 128 bit AES / DRM or similar encryption logic.
- CEDS compliant Relational Database.
- Unstructured Data storage.

TWO core pieces of the system:

The low bandwidth lecture transmission protocol / mechanism shall consist of three sets of encoding and decoding libraries, and one set of multiplexer and a demultiplexer.

Audio encoding

Use FFMPEG open source library to encode PCM (Mic captured audio) into 4.75 kbps, mono, 8 Hz AMR-NB audio. The objective is to be able to stream live audio within 5 kbps (Quality 3.8)
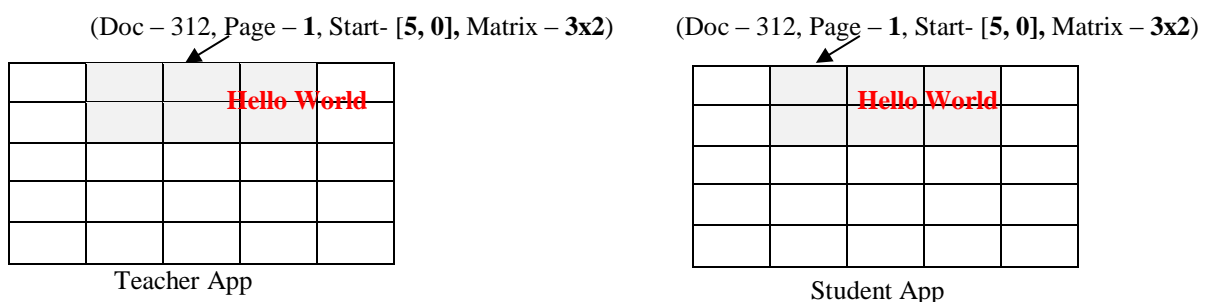
Whiteboard / annotation activities

The synchronization is done by sharing mouse / key event in real-time. The white board activities both in whiteboard only mode and in the presentation mode (annotation) shall be relayed to the learner's app as predictive key events. Predictive key event sequences are well defined in good whiteboard APP, including the bigbluebutton (www.bigbluebutton.org <http://www.bigbluebutton.org>) and opensankore (<http://open-sankore.org/>), both are the open source project.

Screen Synchronizer

The screen synchronizer in the presentation mode shall allow the teacher's screen to be replicated at the student's mobile app sharing doc_id, page_id, and matrix info of the focused screen section. The info on the dirty rectangle can be found from reading the frame buffer.

For example:

(Doc – 312, Page – **1**, Start- **[5, 0],** Matrix – **3x2**)   (Doc – 312, Page – **1**, Start- **[5, 0],** Matrix – **3x2**)

Teacher App   Student App

<u>Multiplexer</u>

The stream, including audio, mouse events, and / or screen synchronizer needs to be multiplexed with minimal overhead (encryption and timestamp) for delivery over the web to all student App. These can be sent through UDP (noncommittal transmission) and the session and signaling can be managed through SIP. A multiplex stream along with a base document / images can be played back through our proprietary player.

<u>Demultiplexer</u>

This is implemented at student app level and shall allow both live streamed data and stored multiplexed data to be de multiplexed and played back through App. Demultiplexer shall have de-encryption and synchronization logic built in along with using a reference image / doc to relay real-life replication of teacher's session.

<u>Transmission</u>

Websocket or any low latency and low data footprint transmission mechanism is required, which can be supported over IP and by mobile APP (Android).

TruTeach objective is to enable a large number of students to learn from top teachers, but as an individual and adaptive pace, hence the platform shall offer several analytic hookup to analyze user / system data and personalize the experience.

The objective of below flags (group sentiment analysis) and personal interaction analysis is to allow teachers to adjust lecture delivery (real-time), optimize lesson planning (offline), additional / supplement material provision to individual (offline).

The below given flags / data collection points are not exhaustive. All the below flags / interaction points shall be recorded per session, per student, per teacher, per course, per geographical location (GPS and/or student profile), and per institute.

Got-it: Thumbs-up, got it move ahead. This can be clicked by students when asked by the teacher.

I am lost: Thumbs-down, did not get it. This can be clicked by students when asked by the teacher. Based on cumulative response teacher and repeat or explain in alternate method.

Have a Doubt: Raise hand to ask livequery – voice / text / scribbling on the board.

Make a comment: Comments are classified and has prerequisite classes – e.g. I didn't get Line [6]

Not paying attention: The system can approximate the student eye time on the session by dimming the screen on decreasing order if no interaction is recorded, touching the screen shall bring it back to the full display condition. An automatic ping / buzzer message goes from teacher to student.

Check me (Teacher administered): MCQ given by teacher during class. Student answers them by selecting option available on the screen.

Test me (System administered): Periodic /Scheduled MCQ test as per course planning.

My Submission: Written submission / OMR sheet based submission which can be clicked by camera and uploaded to appropriate assignment area.

How am I doing / My Dashboard: The report showing several recorded and analyzed data, including, lecture attended (segmented chapter wise), score (in-class), score (scheduled exams), performance (among the group), Gap area, etc.

How is my class doing / Teacher Dashboard: The teacher dashboard can provide data per course – number of lectures, total duration, content quality, delivery quality, student improvements, etc. as analyzed by above data capture.

How is TruTeach doing / Overall Dashboard: Total course, the total number of hours of lecture, total numbers of students, number of tests, cumulative score improvements, etc.

TruTeach Mobile App shall allow users to register as student, browse through courses listed under various categories, register for interested course(s), attend live lecture, collaborate with teacher / student both through online & offline session, view offline / archived content of the registered course, administer assessment, and analyze performance.

- The student shall get timetable attached with course regarding, live lecture schedule, exam schedule, course completion schedule, etc.
- The student can set himself a calendar reminder for scheduled events. The student shall get email / message / announcement of upcoming events and/or other course related matters.

Conclusion

In an emerging nation like India, finding the proper skills in majority of semi-urban and rural component to conduct effective doubt solving and Group discussion is challenging tasks. Once children come to school with doubt and are unable to seek assistance due to lack of support they lose interest in further study.

The idea of synchronous adaptive learning emerged from this personal experience. We expect students to go through pre-designed concept video and in building assessment during self-study time. While the student works through his lesson at his convenience, system identifies and accumulates doubt areas, group weakness, most sought out topic, interest area, etc. This information in real-time is analyzed and used to create a proper lesson plan for teacher to use for synchronous adaptive teaching.

The teacher uses the platform to deliver doubt solving and knowledge enhancement session in real-time to learners connected via classroom or via personal mobile devices over a 2G or better network infrastructure. Teachers are guided through the session about various real time attributes of students, including understanding, not understanding, bored, focuses / not focused, quick learner / slow learner, etc. to pace their interactions accordingly. Lastly the system at the end of the session automatically sends supplement and complementary learning / intervention / assessment material for individual students based on their performance.

The good news is that the government is also focusing on digital education pan India. The Indian Government is taking initiatives such as the Right To Education Act, Sarva Shiksha Abhiyan and allocates of nearly US $1 billion in the 11th Plan for the National Mission on

Education through ICT. The National Policy on ICT in School Education of the Union Human Resource Development ministry contains a roadmap for implementing ICT literacy in all schools, and we are hopeful this technology will become a reality in education sooner or later.

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