HCI for the Next Billions

Nitendra Rajput

IBM Research, New Delhi

IHCI, Las Pamas, July 22, 2015
Overview

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One man.
One computer.
Ten million students.
Our $1.3 trillion
school system is
ripe for revolution.

Gartner
Predicts 2013: Digitalization Powers Education

21 November 2012

Bill Rust  Allen Weiner  Marti Harris  Jan-Martin Lowendahl

The how, when, where and what of learning will be dramatically disrupted as bits and bytes supplant time and place as the value propositions in the education ecosystem. This research highlights some predicted disrupters to the ecosystem over the next five years.
Challenges in Indian Education System

Poor quality of education at all levels

It is estimated that ~75% of technical graduates and ~85% of general graduates are unemployable by India’s high-growth global industries.

“Our university system is, in many parts, in a state of disrepair…in almost half the districts in the country, higher education enrollment is abysmally low…almost two thirds of our universities and 90% of our colleges are rated as below average on quality parameters”. Dr. Manmohan Singh, 150th Anniversary, Univ. of Mumbai (2007)
Poor Quality of Instruction…..

• According to a 2004 report, at school levels, ~51% of teachers are higher secondary qualified or below - including ~24% secondary, 4% below secondary. Only 31% are graduates.

• Only 44% of teachers have received some form of in-service training.

• Teacher-student ratio has sharply deteriorated e.g. from 1:20 in 1951 to 1:43 in 2002 (primary level). Difficult to provide individual attention.

• Nearly 20% of primary schools have just one teacher and 43% have just two teachers. 1.4% primary schools have no teacher. (District Information System for Education Report for 2003)

• At the University level, >50% of teaching posts are lying vacant on an average, amongst universities surveyed by UGC.

• Low teacher motivation results in high degree of absenteeism
  —According to a World Bank report, 25% of teachers were absent from school and only half were teaching, during unannounced visits to a nationally representative sample of government primary schools in India.

<table>
<thead>
<tr>
<th>Country</th>
<th>Teacher absence (%)</th>
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<tbody>
<tr>
<td>Peru</td>
<td>11</td>
</tr>
<tr>
<td>Ecuador</td>
<td>14</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>15</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>16</td>
</tr>
<tr>
<td>Zambia</td>
<td>17</td>
</tr>
<tr>
<td>Indonesia</td>
<td>19</td>
</tr>
<tr>
<td><strong>India</strong></td>
<td><strong>25</strong></td>
</tr>
<tr>
<td>Uganda</td>
<td>27</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Level</th>
<th>Total Sanctioned</th>
<th>Total Filled</th>
<th>Total Vacant</th>
<th>% Vacancy</th>
<th>N = No. of sample university</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof</td>
<td>2469</td>
<td>1367</td>
<td>1102</td>
<td>44.63</td>
<td>45</td>
</tr>
<tr>
<td>Reader</td>
<td>4506</td>
<td>2194</td>
<td>2312</td>
<td>51.31</td>
<td>46</td>
</tr>
<tr>
<td>Lecturer</td>
<td>9604</td>
<td>4503</td>
<td>5101</td>
<td>53.11</td>
<td>44</td>
</tr>
<tr>
<td>Total</td>
<td>16579</td>
<td>8064</td>
<td>8515</td>
<td>51.36</td>
<td></td>
</tr>
</tbody>
</table>

Table: Vacant Positions in Sample Universities
Poor Quality of Infrastructure

- Educational infrastructure
  - Teachers are largely dependent on conventional tools like chalk-boards for teaching and have almost no access to other supportive materials, or any means to share or re-use resources
  - Text books are updated infrequently, often contain errors, and due to lack of localization, they are often not engaging. Learning by rote is encouraged.

- Physical infrastructure
  - Poor quality of buildings, inaccessible roads, lack of basic facilities, shortage of electricity; 90% of school budget in government school goes towards salary payment
  - A study of 188 government-run primary schools in central and northern India revealed that 59% of the schools had no drinking water facility, and 89% had no toilets.

Thus despite basic education being virtually free, a large segment of our population does not see or receive the intended benefits of education.

Drop out rates are still very high: 95% join primary education, only 40% proceed to secondary, and only 7% reach beyond 10th grade.
The new wave of sensors, wearables, cognition and mobile computing provides endless possibilities for IBM to define and lead the changes in (a) the manner in which this content can be created, (a) the educational content and its consumption patterns that can be analyzed, and (c) the manner in which the interaction can change for effective learning.
Creation Transformation

- Understand the unique value proposition of mobile for content creation as opposed to content consumption/delivery
  - Exploit unique sensors such as location, camera, microphone etc.
- Collaborative content creation and verification as opposed to single point of creation in LCMS (multiple authors)
  - Crowdsourced meta-data a la ESP game
- Demand visibility for content creation
  - Experts know what content users are demanding and stress on that
- Incentive mechanisms for quality content creation
  - On demand content creation
  - Fair usage policy (use if you create)
- Interesting visualization and consumption of the data on mobile from the cloud

Most content creation is now from mobile devices

Derive additional meta-data about content, such as location, state, etc.

Will enable possibilities of faster and localized content creation

Develop mechanisms to enable easier content creation from mobile devices
Creation Transformation Example: EduBay

**EduBay**

- Seamlessly capture and attach metadata
- Location based visualization
- Crowdsourced verification
- Content demand visibility
- Fair usage policy

- Bring together content creators and consumers
- Android application with a backend server, media repository, and metadata DB

**Creator**

**Consumer**
# Interaction Transformation

<table>
<thead>
<tr>
<th>Haptics</th>
<th>Google Glasses</th>
<th>Augmented Reality</th>
<th>Gesture Based Interface</th>
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<tr>
<td>• No longer passive content streaming to the student&lt;br&gt;• Detect user attention and interest through various sensors&lt;br&gt;• Students interact not only through touch screens, but by tilting the device, gesturing to the device</td>
<td>• Make the teacher-student interaction richer and meaningful by overlaying student information&lt;br&gt;• Make passive text books more interactive by detecting related content and beaming on glasses</td>
<td>• Bridge the gap between real world and the virtual world by building technologies that can interact with the real world&lt;br&gt;• Develop mechanisms to make a paper rich!&lt;br&gt;• Use QR code based technologies to bridge this gap</td>
<td>• Build systems, especially for accessibility, that can take user input through gestures&lt;br&gt;• Borrow from gesture based games to the education world&lt;br&gt;• Provide richer and differentiated education experience through richer user input mechanisms</td>
</tr>
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</table>
Interaction Transformation Example: Learning Path using QR Codes

1. Students check out a job opportunity and captures the skills required for the job that are provided as a QR code in a news paper.

2. The mobile scans the QR code and shows the target skills that the user needs to acquire for this job.

3. The user can overlay his knowledge graph (skills that he has already acquired) and generate a learning path.

4. The user then selects a particular concept identified in the learning path and starts the learning.
Analytics Transformation

- Using Smart Phone sensors to determine the context of the student
  - GPS: Outdoor location
  - WiFi: Indoor location
  - Accelerometer: User movement
  - Bluetooth: User group
  - Barometer: User height
  - Microphone: Noise level of environment

- Conducts situation-centric deep context data collection about users via smartphones

- Opportunities to perform analytics not only at a course/performance level, but also at an interaction level to
  - increase user attention
  - provide real-time feedback
  - adapt to the environment
  - enable real-time collaboration
Analytics Transformation Example: VibRein

User watching an educational video

On incorrect answer the video is rewound back to the point where concept was explained

Frontal face detection to know user attention

Buzz

The user is asked a multiple choice question about some concept being taught

Use haptic feedback to bring back attention of an inattentive user

The user can answer the question using tilt gestures on the phone based on gyroscope, accelerometer

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One can learn science through lectures, but there remains a huge gap in terms of conducting experiments. No physical school is without a chemistry or physics lab. However, none of the current solutions in the Online Education space cater to experiments. Need to develop methodology and set of technologies to create virtual experiments toolkit to complete the online education story.

Use the gyroscope and accelerometer sensor to determine effect of moving physical objects. Use advanced visualization techniques to enable changing of the objects based on the movements and the associated events. Identify the physical objects that can be modeled by the mobile device and then determine the experiments that can be conducted on such an object. Develop a platform that can model the reaction of the physical objects and can enable creation and customization of virtual experiments.
Chemistry Experiments Example

Pour chemicals using the tilt sensor. Tangible chemical experiments with safety of no actual chemicals.

Shake after mixing chemicals as required in chemistry, using shake (accelerometer). Improper shake can be made to result in improper reaction as it happens in real.

Stirring and centrifugal mixing using rotation of phone on the table (gyroscope, accelerometer).
Stirring and centrifugal mixing using rotation of phone on the table (gyroscope, accelerometer).
An after-school mobile phone based audio game for students in rural India.

Primary aim is to improve the Spoken-English language skills. The game also incorporates English spelling learning and word-meaning learning.

The content of the game is based on the books and the curriculum of the schools.

The game can be used by calling the toll-free number: 1800-1020-426. The users does not have to pay for using the game.
### Overview

#### Style

- The real situation
- Where HCI can help
- Some examples

#### Content

- Healthcare
## The Healthcare Landscape

### Economy, Selling Environment
- Healthcare spending is 5% of GDP – among the lowest in the world; government funds ~33% of expenses – also the lowest.
- 2011 IT spend within 1,000+ market: Payor $50M; Provider $60M; CAGR 2011-15: 13.4% and 14.7% respectively.

### Regulatory Environment
- India has a social security-type public health insurance system, but covers only 20% of population; as a result, citizens’ pocket expenses are high at 68% of total healthcare spending – one of the highest in the world.
- The government funds 26% of healthcare spending; 74% from out of pocket expenses and private insurance (20% of population has private insurance).
- The Dept. of Health sets national healthcare policies and establishes spending priorities; initiatives are set in 5-year plans; the central government oversees 28 states and 7 territories.

### Technology Adoption
#### Drivers / Inhibitors
- The healthcare market is $70B in 2010; will grow to $125B in 5 years; hospitals are 50% of spend; private hospitals to benefit due to poor public health.
- High-growth IT areas will be in analytics and collaborative tools.
- Telematics and telemedicine are increasingly being used to reach a wider group of patients, especially in rural areas.
- Videoconferencing with electronic medical records have enabled patients to gain access to doctors and avoid health centers that often lack skilled medical personnel.

#### End-user Trends
- Shortage of doctors and other clinicians – below WHO limits.
- Private providers offer world class care and invest heavily in IT and new technology, while public providers lag.
- Foreign-based insurers must form joint ventures with local companies to operate.
- Private health insurance grew 41% over the past 4 years and is expected to reach $7.7B by 2015.
- Medical tourism expected to be $2B in 2012; govt investing $6.5B in next 2 years to support medical tourism and is offering special medical visas.

### Industry Leaders, Local Ecosystem
- 11,289 hospitals; 70% are public, but private hospitals treat 70% of all patients.
- Government-run General Insurance Company and its 4 subsidiaries are key insurers.
- Foreign-based insurers include Cigna, NY Life-UK insurer BUPA partnership, MetLife, Aetna, UnitedHealth.
- Apollo, Fortis Healthcare, CARE Hospitals, Manipal Group, and MAX Healthcare are the top private hospital chains.
- IT leaders are Wipro, GE Healthcare, Microsoft, Siemens, Vepro, Tata, BirlaSoft, Sobha Renaissance.

### M&A, Key Alliances & Announcements
- The government is pushing private-public partnerships (PPP) to expand healthcare.
- July 2011 Fortis has 8 hospitals in development for 1,400 beds.
- May 2011 Apollo Hospital is expanding in Hyderabad by 100 beds for medical tourism, and Hyderguda hospital by 175 beds.
- May 2011 Fortis acquired 71.5% of Super Religare Laboratories (SRL).
A maternal death every 10 mins in India: UN

New Delhi: India is likely to miss the Millennium Development Goal (MDG) related to maternal health as one maternal death is being reported every 10 minutes in the country now.

India recorded around 57,000 maternal deaths in 2010, which translate into a whopping six every hour and one every 10 minutes, UN data in this regard says.

The current Maternal Mortality Rate (MMR) of India is 212 per one lakh live births, whereas the country’s MDG in this respect is 100 per one lakh live births by 2015.
Motivation...

- Women are mostly shy discussing issues with male doctors, so an automated system will be much less intrusive.
- Useful for low literate users.
- Women can gesture a specific action to explain a problem rather than speak to it.
- Conducted a ethnographic study for 2 months in Remote areas in Assam to derive these insights.

Solution...

- Gesture based health information system.
- Low literate pregnant women from villages in Assam.
- Mostly Assamese, with a variation in the local dialect.
- Currently works on Kinect (can be deployed using another Camera).
- A voice IVR system to record questions from the women, which doctor can answer through their phone.
- Health care information on medical checkups, food habits, good practices etc.
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Sugarcane Farming

- Sugarcane farming scenario
  - Collect sugarcane from farmers around the state
  - Cane is processed at the Mill to produce several products
  - If Mill has reached its capacity to process sugarcane, it rejects the farmer’s produce that day
  - Results in drying of the sugarcane and loss of revenue to farmer
System Usage

- Information announcement system to farmers from the sugar factory
- 6500+ registered farmers
- Integrated Web front-end
- Launched in January, 2010
- Received more than 30,000 calls from 1600+ unique callers in 3 months
- Farmers recorded 7000+ questions
The Farmer’s Facebook(?) on Voice

Flowchart:

1. Main Menu
   - Question
   - Announcements Board
   - Question & Answers Board
   - Radio
   - New Response

- Entry
  - Signature Tune
  - New Message?
    - No: 1. Main Menu
    - Yes: New Response
Pilot Launch: Dec 24, 2008

Report Summary (as of Feb 29, 2012)
  - Total number of calls received = 52428

Services Accessed
  - Question & Answers 34211
  - Announcements 1243
  - Radio Programs 7529
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HCI for the Next Billions

is not good to have – but is essential

Nitendra Rajput (nitendra@acm.org) (@nitendrar on Twitter)

IBM Research, New Delhi