The AGEM Project

Developing World - E4A

We have created an introductory youtube video to this DNLE proposal at (http://youtu.be/yT5eb1KV3J4). We would recommend viewing that before reading through the next section on "How to read this document" (Part I), the Executive Summary (Part II) and the Table of Contents

Contents

Part I.
How to read this document

- There is an executive summary you may want to go through before you explore anything else.
- Any text that has a color other than Black is a link that connects you e.g. to a footnote, a bibliography, or an external link. Feel free to click on these to explore the link though that may not be what you want to do at first reading. Some of the links are to youtube videos so you will need an internet connection to see those.
- To make it easy to go back to where you were before you clicked the link, if you are using Adobe Reader you may want to set up a "Previous Page" which you can do by following the menu to View, Toolbars, More tools, Previous Page. Click **here** to see what it looks like.
- There are two animations which are important and will start automatically when you go on to the page. If you want to restart them you can put your mouse pointer over them or you can change the page.
- Each item in the table of contents is clickable. This means if you click them you will go to that particular section. If you have set up "Previous View" you can go back to where you had clicked.
- Please note that every item in the Table of Contents is similarly linked to the different sections of this document.
- The Internet links seem more reliable when the pdf file is dropped into the firefox browser and the links are clicked from there.

Part II.
Executive Summary

Introduction

The AGEM design is the result of 12 years of evolving research. Much of the learning has come from first implementations in two international schools, and one Pilot Study at a Church school for lower income families. However, it is the experience of working with children in difficult circumstances in 8 states of India for short periods, and the 4 year experience in auditing International schools, that led to the solutions that constitute the AGEM design. See Section 10.

We have learned that the great need is for the poorest to have a meaningful education if only because it can create the entrepreneurial skills that can loosen generations of poverty. State government schools represent the educational outlet for this constituency and therefore become the principal AGEM priority.

1. This system is the result of 12 years of observation and research which is detailed in section §10.

2. The primary audience for this project is schools for the poor, primarily government schools.

3. The project has been designed (section §3) to be scalable across thousands of schools, affordable by Indian standards, measurable in its effectiveness, and effective in pursuing the goals envisaged.

4. The perceived needs are twofold. The first is to bridge the gap between what the education system produces and what industry and academia need (section 2.1.1). The second is to provide a meaningful education (section 2.1.2) which creates abilities to:

   a) apply what has been learned in new circumstances

   b) make gray area decisions

   c) participate in teams to arrive at a decision

5. We are of the view that the first initiative will be directed at urban schools starting at Grade 6 and proceeding to Grade 12. We see the educational ecosystem in India being on a "poor to fair" journey of improvement (McKinsey's Journeys of improvement and Summarizing the state of the ecosystem). The McKinsey report suggests the need for a prescriptive approach at this stage to achieve the basics of literacy and numeracy which we concur with. We do not recommend this approach to ecosystems that are at a different stage of the journey.

6. The unique elements of our approach result from its functional elements (Functional elements of AGEM):

   a) the centralized production of Topic Plans containing embedded questions

   b) Wireless feedback devices for students to respond to embedded questions

   c) Representations which show the response of the class as a whole without identifying individual responses. See section §5.

   d) Archival and analysis of all responses so that we can guide students, teachers, schools and ourselves on how best to improve everyone's performance.

7. Click here to watch a short youtube video of an AGEM class if you have Internet connectivity.

8. We measured the impact of AGEM methods through conducting a Pilot at a school for poor urban children in Bangalore during which we got less than 20 hours to conduct formal Topic Plans in Mathematics for Grade 6 students. We found the principal impact to derive from:

a) student engagement with almost no indiscipline

b) development of inferential ability

c) decreasing gap between the strongest and weakest students

d) an improving spirit of collaboration

9. The more specific quantitative impact (section 11.1) was:

   a) students we taught went from an average pre-test score of 24% to a post-test score of 75% when tested using more than 60 questions in both tests. The questions were taken from a US developed placement test in Mathematics although American names were replaced with Indian names.

   b) the gap between the scores of the best performing student and worst performing student went from 63% of the best score to 33% over 4 Topic Plans.

   c) 77% of the taught group did better in the schools Term 2 examinations in Mathematics as opposed to 51% for the rest of the class. The average increase for the taught group was 7.5% and for the rest of the 2.7%

   d) This difference in performance was also visible in the Science and English exam results. We had taught only maths.

10. The investment required for this project (Part VI) is USD850,000 over a 2 year period and ROI is expected to be achieved in the third year when 200 schools with an average of 9 classrooms will be outfiitted. This will generate a profit of USD30 million in Year 5.

11. The costs of participation (section 17.4) for each student are a one time registration fee of USD 20, and an annual fee of USD 72 per year for learning Maths, Science and Systems Thinking. We do not see the need for more than 2 hours a week of AGEM learning in each of 3 subjects in the first years of adoption.

12. These costs assume provision of at least 1 outfitted classroom in the school which needs to provide seating and a power source, although we have a backup battery for upto 8 hours of operation. Beyond pencils and paper we supply the remaining equipment within the costs cited above.(section 6.2)

13. The market (section 17.2) for these services in the State of Karnataka which will see the initial rollout is 1 million students each in Grades 6, 7 and 8. These are spread over 13,447 High/Secondary schools.

14. There are plans for added services (section §14) which include training of teachers, developing technology for student projects, working with schools to establish and improve their quality of service indices etc.

Part III.
The rationale

1. The ecosystem

1.1. The structures

The ecosystem comprises private and government schools which adopt either the state examination board or one of two central examinations boards. Alternatively, for private "international" schools overseas boards such as University of Cambridge International Examinations (CIE) and the International Baccalaureate (IB) are becoming more popular.

The Indian Constitution requires Education to be a concurrent subject i.e. both the Central Government and State Governments are responsible for providing education till the age of 14. However, state governments do the implementation. Municipal schools form a small fraction but there is a concept of "aided" schools which receive support from the state government with funds disbursed by the central government. See Section 17.2 for numbers.

1.2. The quality of education

1.2.1. The why of quality

The shift from free Govt. schools to fee paying private schools Educational quality is widely criticized within the country with a strong tendency for even the poor to move their children from free govt. schools to fee paying private schools. There is no clear evidence of a logic behind this but there is an underlying belief that "meaningful education" is the highway out of poverty and government schools are not offering adequate quality of education.

Impact of poor quality education Poor quality education is not "meaningful". However the root cause of poor quality education is systemic in nature. The output of such a system feeds into higher education and therefore into the quality of teachers, the quality of higher education and the quality of teacher training and educational research. More importantly it diminishes creativity and ethics.

Poor quality education and the "Wicked" problem A poor education system is reminiscent of Horst Rittel's "wicked problem"[4] where the level of complexity is such that there is no solution that solves the problem, and the situation can only be made better or worse. Also there is no stop rule i.e. one cannot at any stage say the problem has been solved. Such problems require system solutions rather than magic wands.

Poor quality education and the examination system Hence, to improve quality, we have to improve the system. One of the elements that determines quality in the system is the nature of the examination system. This dictates what is examined, and therefore, in practical terms, what is taught.

However, examination boards have a fundamental duty to ensure that across this very large and disparate country, assessment is conducted in a reasonably standard way, so the same question, say in a Kashmir village, should get roughly the same marks from an examiner as it would in Delhi. For this reason, questions have to be discrete in nature i.e. a single right answer with few grey areas. This promulgates an atmosphere of, "Why read Shakespeare? Just buy the guide to the Shakespearean play that is on the Syllabus". That guide contains questions and answers that students focus on remembering - the rote learning approach. It is hard to imagine a greater injustice a nation can inflict upon its children.

1.2.2. The current state of the ecosystem

McKinsey's Journeys of improvement

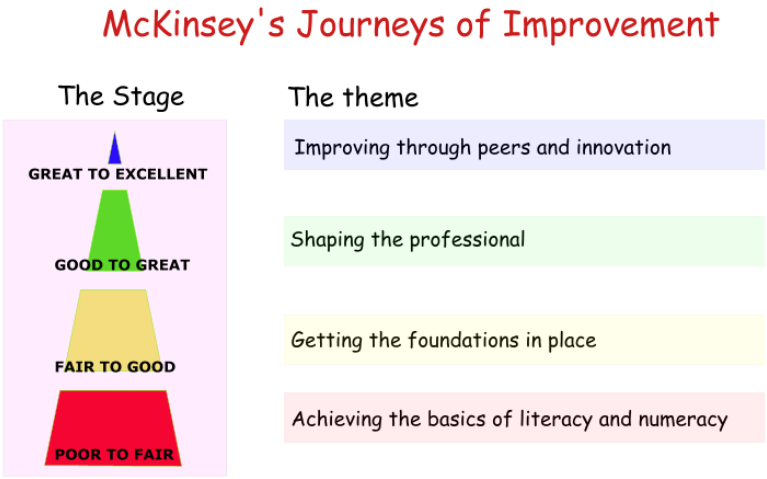


Figure 1: McKinsey's Report: "How the world's most improved school systems keep getting better"

In a landmark study[3] McKinsey investigated 20 educational systems at various stages of quality, that are improving in significant ways. Some of the relevant findings for us are:

- There are four stages in the journey from poor to excellent systems - poor to fair, fair to good, good to great and great to excellent.[1]
- The guiding principle at the Poor to Fair stage is Prescribed Adequacy which proceeds to Unleash Creativity at the great to excellent stage.
- Prescribed adequacy is characterized by:
  - ▷ Prescriptive teaching materials in the form of scripted lessons.
  - ▷ Technical skill-building
  - ▷ External coaches - providing coaches to visit schools
  - ▷ Increasing school visits by central leaders and administrators
  - ▷ Increasing instructional time on task

For reasons we shall see below, the Indian education system needs to go from the state of being poor to being fair.

[1] Poor to fair: the interventions in this stage focus on supporting students in achieving the literacy and math basics: this requires providing scaffolding for low-skill teachers, fulfilling all basic student needs, and bringing all the schools in the system up to a minimum quality threshold. Systems on the journey from poor to fair, in general characterized by less skilled educators, tightly control teaching and learning processes from the center because minimizing variation across classrooms and schools is the core driver of performance improvement at this level.

The PISA Report

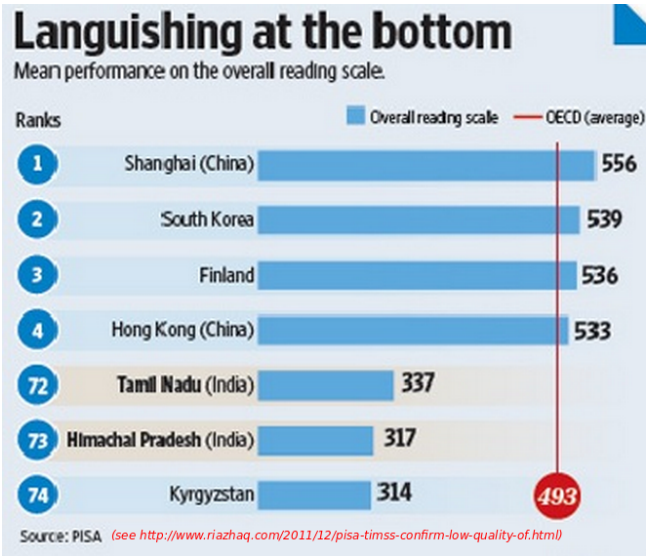


Figure 2: Ranking of two Indian states - Tamil Nadu and Himachal Pradesh in the PISA Report

The results of the most recent PISA report when Indian states (the two frequently considered the best in India) were measured for the first time, are shown in Figure 2

The Dropout Rate The latest report from the Ministry of Human Resource Development cites the dropout rate between Grade 1 and Grade 10 as 43.3% for the State of Karnataka, and 49.3% for the whole of India. Many of those who drop out are girls approaching puberty either because of the lack of toilets in schools or because of the need to look after a male sibling in the home.

Summarizing the state of the ecosystem Both the dropout rate and the PISA ranking of possibly the most advanced Indian states on the educational front indicate the current state of the ecosystem that AGEM seeks to improve. **This also shows that the first transition Indian education has to make is from poor to fair as defined in the McKinsey report's journeys of improvement. For most states in India this journey has not begun.**

1.2.3. Improving the ecosystem

The AGEM approach to a better system is vested in the following beliefs:

- children when presented with meaningful education rendered through differentiated learning even though such children may have been largely deprived of social opportunity, can transcend into what Mihaly Csikszentmihalyi[2] has termed "flow", which he has described as follows:
  - ▷ "Enjoyment appears at the boundary between boredom and anxiety, when the challenges are just balanced with the person's capacity to act."
  - ▷ **Here** is an extract from a video of a class of Grade 6 students.
- assessment has to be fair, neutral and devoid of public humiliation.
- high stakes examinations may be replaced with continuous in line assessment. Application of knowledge can be tested by a scaffolded approach to student portfolios.
- feedback delayed is learning denied when it comes to designing classroom interventions.

- the reality of Indian education is large classes and this has to become an advantage rather than a problem
- no system of more than 100,000 schools can be overturned, but it can be modulated
- curricula cannot be changed overnight but it can be complemented and gradually replaced due to the sheer contrast of quality of a new initiative. That is the modulation process for the poor to fair stage.
- the energy of adolescence can be harnessed though education. Grade 6 classes are the low hanging fruit for modulating an education system.
- teachers have to become partners as well as learners in any new system.
- any form of mental, physical and verbal abuse has to be prohibited. Eliminating boredom is one way of doing this.
- examination boards need to be changed in two ways:
  - ▷ Top down: by research and advocacy impacting educational policy
  - ▷ Bottom up: by implementing, monitoring and researching modulations.
- There is a widespread tendency in India to attend coaching centers to get some qualification or beat the test for entry to prominent educational institutions. Recently this has led to a spate of suicides from one Indian state which had found effective methods of beating the test for the Indian Institutes of Technology admission exams. One impact of that has been a spate of suicides by students who were successful, but presumably could not cope with the workload at the institution, and could not go home because of the investment the parents had made to secure them admission through the coaching centers.
- Any technological solution has to be open source not just because of cost but because of the scope for children and the open source community joining hands to provide continuously improving solutions.

2. The need

2.1. The general need

The general need is for addressing two issues.

2.1.1. Bridging the void

The first is, bridging the void between capacity of the outputs of the educational system, and the requirements of the workplace/tertiary education.

Industry leaders have voiced sentiments similar to those below over the years. Two of them are very telling.

Manish Sabharwal Sabharwal is Chairman of TeamLease, one of India's largest white collar employers. He said, "As a staffing firm, TemLease sadly does not hire 95% of the youngsters that come to it for a job. As a training firm, it estimates that 40% of these job-interview rejects need more than a year of "repair" or "preparation" to make them truly job-ready.

Mohit Chandra, KPMG Writing in the New York Times Blogpost in a controversial message to the students of India's elite business schools, he wrote,"Most of your contributions will be substandard and lack ambition, frustrating and of limited productivity. We are gearing ourselves up for broken promises and unmet expectations. Sorry to be the messenger of bad news.

Today, we regret to inform you that you are spoiled. You are spoiled by the "India growth story"; by an **illusion that the Indian education system is capable of producing the talent that we, your companies, most crave.**"[2]

2.1.2. Providing a meaningful education

A meaningful education, in our view, implies 3 strategic goals:

1. Inference: This means developing inferential capability in students so that the knowledge gained can be applied to new circumstances.

2. Decision making: This means developing decision making ability. In most of our target schools children are rarely engaged in making decisions, and in many ways, making competent decisions is the differentiator between a child and an adult.

3. Participative decision making: We aim to build a sense of participative decision making. This reflects real life capacity issues which apply in a family as much as they apply in a community. They invariably involve listening to, and understanding other points of view, presenting persuasive arguments, and making needed compromises through dialogue.

2.2. The general strategy

The general strategy is typified by two goals. We work on the assumption that human capacity is a normal distribution in a population represented by the popular bell curve.

The first goal is to reduce the bandwidth of the bell curve of human performance in terms of government schools. This reduces the range of variation in the population so that more people are closer to average. This is represented by the animation in Figure 3.

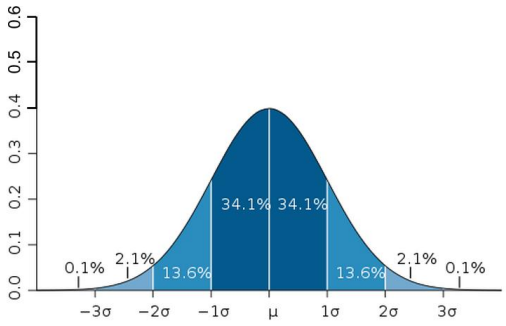


Figure 3: Reducing the range of performance in the population

The second goal is to move the bell curve to the right. This means that the average gets greater. In other words there is a general improvement in the average levels of performance. This is represented by the animation in Figure 4.

[2]The bold font and emphasis is of the authors

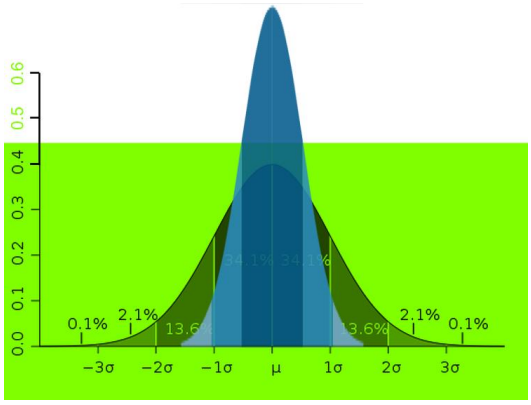


Figure 4: Improving the average performance

As we reduce the range of performance, we make performance less unpredictable. This is of particular value for universities who need to plan courses and for employers who need to fit an employees skills to a job.

At the same time, as we increase the average capacity we can expect to see a surge in productivity. The primary issue is having a critical mass educated in this manner. Pearson's[5] "The Learning Curve" elaborates on this when it says, "Two correlations show a connection between national income and aspects of academic success: higher GDP seems related to better Grade 8 PISA results; and a better score on the Human Development Index (of the United Nations Development Program – UNDP) and its Income Index are associated with higher upper secondary graduation rates."

3. Design rationale

The rationale for the design is to have a methodology that is:

Scalable across thousands of schools so a critical mass of "improved" students can drive adoption of the AGEM strategy.

Effective in fulfilling the three strategic goals outlined in Section 2.1.2

Measurable in demonstrating effectiveness.This is vital to provide credibility to a new initiative.

Affordable in the context of government schools in India. We would hope to reduce the cost of education in India which is driven by textbooks.

Finally, we expect to have an audit trail for each student across the school years primarily to assess individual attributes with a view to providing:

- career guidance for the student
- skills and attributes guidance for employers
- short term and long term analysis for remediation of individual areas of weakness and for identifying, exploring, nurturing, and developing innate talents.

Part IV.
System function and features

4. Functional elements of AGEM

There are principally 4 functional components of the system:

- The topic plans with embedded questions designed to provide differentiated instruction in small steps. The topic plan also contains a talking head display and audio which explain the more complex concepts.
- The full keyboard wireless feedback devices
- The local server with integrated battery backup and GSM data connectivity
- Software for capturing responses and generating representations of student inputs

These elements are conducted by a teacher with at least limited domain knowledge. The function of the teacher is primarily to start and stop the program, proceed with the topic plan, and explain the representations and generate discussion. A 3 minute segment of such a plan being delivered to Class 6 students can be viewed at this link. An AGEM teacher benefits in 3 ways from this approach:

1. The engagement of children resulting from the interactivity caused by the keyboards virtually eliminates problems of indiscipline.
2. Facilitating the conversations that ensue from the display of representations provides both teachers and students a nuanced understanding of the content. More importantly, students and teachers become partners in exploring the subject.
3. The massive effort that goes into creating the topic plans acts as a learning experience for teachers in an education system that is in the "poor to fair" journey.

5. The technologies

There are several technological areas:

1. **The Wireless Keyboards:** These are designed for very low battery drain as batteries are expensive in India and changing these frequently will add to operational costs. Currently the batteries can last for 1-2 years depending on use. We have successfully tested a maximum of 65 keyboards at one time but the theoretical limit is 128. (**A Keyboard**)
2. **The server:** It does not make sense to develop a server for large scale use until we can get funding. We currently use a laptop but we are able to design a low cost, low power drain server which would incorporate a GSM card to receive Topic Plan data and transmit student responses to a central server.
3. **Representations:** We have developed several rich and varied ways of representing the responses from students both for text and numerical data. We believe these are a primary factor in creating impact. Some of these can be seen **here**
4. **Software:** The software for making the system run at the driver level and the User Interface level has been developed over several years.

The current version of software and hardware has been tried out on a large number of occasions over the last 4 years including for the Pilot Study. Apart from the initial problems when testing the design, we have successfully run a large number of seminars attended by over 200 people where we try to explain what we are doing and why. A sample of such a seminar at a local school can be viewed at this link.

6. Infrastructure requirements

6.1. Initial initiative

Infrastructural requirements at the school itself can be limited to providing parking space in the event that we have a bus outfitted for this purpose which can visit several schools that are in close proximity. Within the bus itself a few modifications will be required principally to:

6.2. Within a classroom

The classroom is expected to be the next stage of adoption by a school which has witnessed the power of the AGEM system through have a limited number of students experience it in a bus.

6.2.1. The Black box

It is feasible for us to bundle our server, projector and battery and connect this to the local power supply for occasional supply of power.

6.2.2. Power supply

LED/Laser projectors can be run on a battery for 8 hours a day providing there is sufficient power to charge the battery at some time during the day.

6.2.3. Furniture

The ideal furniture for our classrooms is based on an MIT Media Labs design which was the outcome of a student dissertation. A photograph of our variant is included at Figure 5. The other end of the spectrum is where there are no desks and children sit on the ground. That is also acceptable.

Figure 5: Inspired by MIT Media Labs student dissertation for desks to facilitate interactive learning

Part V.
Target audience and limited conditions

7. Target audience

Our target audience is Grade 6 students in the first instance in state government schools in India. We would then progress with the cohort to Grade 12.

The rationale for this is:

- we have declared our intention to prioritize schools on the journey from "poor to fair" (See Section 2.1.2)
- Our experience is that the energy of adolescence can be easily turned into passion for learning within 30 hours of student contact time.

- Grade 6 seems an appropriate stage to start from as it marks the first grade of middle/high school. There are several years before the rote learning for Examination Board testing commences.

We believe that in Grades 6 to 8 we can provide an educational experience that will prepare them for life as well as for the Board examinations. At the same time this will demonstrate the relative effectiveness of our methods and that may allow us to take the students into the examination board years. We believe that an element of training in entrepreneurial skills at the Class 10-12 stage would entice many to create jobs rather than look for a job.

8. Process

The AGEM process is:

- preparation of high quality topic plans
- delivery of topic plans yielding performance data and creating learning.
- archiving data, determining trends for each student, teacher and school through analysis of data. Specific strengths and weakenesses are identified not only in a specific discipline but across disciplines.
- despatch of reports based on the analysis to the school for dissemination.

9. Value of the learning environment

The value created by this learning environment can be cited as:

- Virtually eliminating disciplinary problems and thereby permitting focus on quality of delivery
- Eliminating the need for textbooks in the classroom for the subjects taught thereby reducing cost.
- Leveraging the value of larger classes through richer representations of student responses thereby bringing economy to the school process. For examples see:
- Providing scalable processes so it will be easier to create critical mass
- Creating collaborative rather than competitive spirit in the student body
- Providing scientific analysis of performance of students, teachers and the school.
- Providing certification of competencies based on thousands of responses during lessons rather than high stakes examinations held at the end of the year.
- Eliminating the need for homework in favour of project work for portfolios.

Finally, the value is best expressed by a set of 25 students from the MVM school in Chennai, India, who were provided the opportunity to attend a session on the first Topic Plan in mathematics. It is worth noting these were Grade 9 and 10 children from an elite school. **Please click here**

10. Needs analysis

While we have not conducted a formal needs analysis over a specified period, understanding of needs has been driven by the following work conducted by Samar from 1998-2009:

- **1998-2000:** Setting up of Vidyashilp School, Bangalore (1998) from scratch, developing the first generation of feedback devices, training teachers, and creating protocols for scaffolding students in the generation of portfolios.
- **2001:** Studying the schooling system in the Maldives while doing an online course with Harvard Graduate School of Education on Teaching for Understanding.
- **2004-2006**: Participated in the design of the Balajanaagraha course in civic governance for about 40 schools in Bangalore ranging from slum schools to elite private schools.
- **2005-2006**: Evaluating the Young Media Club project in Vietnam by interviewing more than 100 children and officials in Hue Province, and developing a proposal for a Child Led Social Equity Audit Program.
- **2005-2007**: Conducting short sessions every year for a group of Tsunami devastated children in South India on Child Lead Social Equity Auditing.
- **2007-2008**: Setting up Trio World School on existing premises and developing the third and fourth generation of feedback devices. Created collaboration with local govt. school where our students taught English to their opposite numbers.
- **2005-2009:** Audited many schools across India offering CIE's GCSE and Advanced Level Programs as a Consultant Inspector for CIE.
- **2006:** Conducting the DFID funded HAAP program working with about 200 HIV infected and affected students in 5 states of India to create a film addressing the issues of stigma and discrimination in respect of HIV infected children. The second generation of wireless feedback devices was tested during this exercise.
- **2007:** Ten day session with a group of children in Kashmir on Child Led Social Equity Auditing.
- **2006-2007:** Creating design studies for projects to further the requirements of the International Convention for the Rights of the Child for:
  - ▷ Plan Vietnam
  - ▷ Plan Region of South and East Africa
  - ▷ Plan Burkina Faso
- **2009:** Coordinated feedback on content of University of Cambridge International Examinations (CIE) Advanced Level course on India Studies.
- **2009-2010:** Maria Niketan Pilot

11. Proof of concept - The pilot study

We conducted a Pilot study at the Maria Niketan School in Bangalore from about November 2009 to March 2010. We delivered 5 topic plans. The first was developed on the basis of the syllabus for Class 5. It was hopelessly unsuitable for Class 5 as well as Class 6. We re-started from scratch assuming little understanding of mathematics on the part of the class. That was the correct approach as we discovered later with other more elite groups.

11.1. The class profile

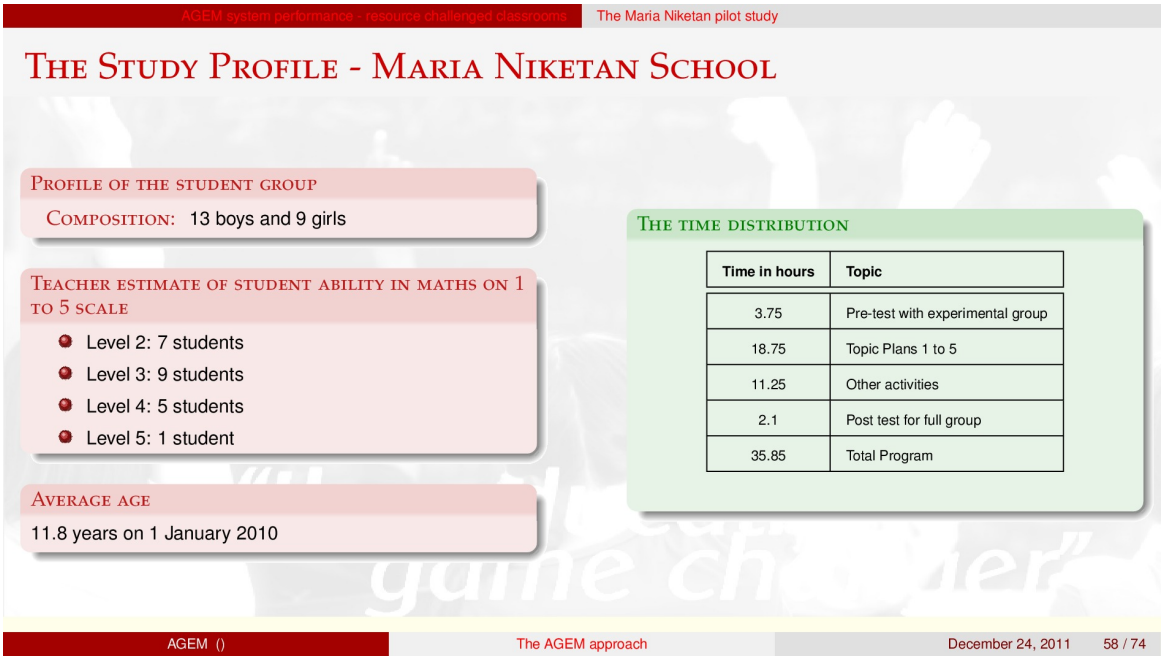


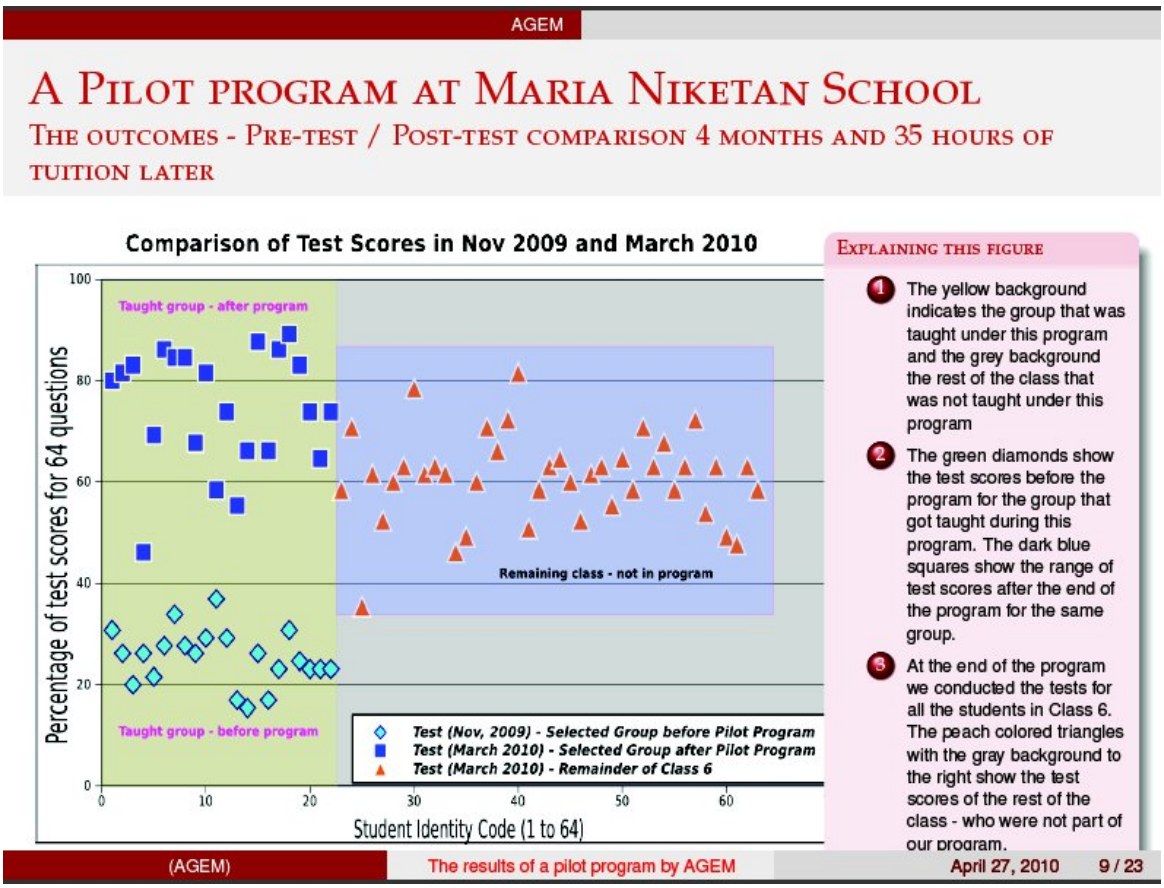
Figure 6: Profile of the experimental group

11.1.1. Observations

The regular Maths teacher was asked to provide a subjective estimate of the Maths competency of each child on our course. It is notable that only one of the students is cited as Level 5.

11.2. Pre and post test performance

A partial set of a US developed placement test was used to measure performance before the teaching sessions began (113 questions) and again after the test (65 questions). All questions which were multiple choice were answered using the feedback devices. Not attempt was made to restrict the time. Students however were generally quick to respond.



	Test Score Statistics			
	Mean	Max	Min	Std. Dev.
Experimental Group - Pre Test	24%	50%	5%	9%
Experimental Group - Post Test	75%	89%	46%	12%
Control Group - Test at end of session	61%	82%	35%	9%

Figure 7: Pre and Post test results

11.2.1. Observations

- Regrettably the control group which was the rest of the class was not subjected to the pre-test. This arose out a misunderstanding where we believed that the students came from several sections of the same grade while in fact they were part of a class comprising about 75 students.
- The experimental group took this course for one hour in the afternoon which was reserved for students to take remedial courses. The rest of the class took remedial courses with the normal teachers depending on individual perceived weakness.
- The taught group whose pre-test scores hover around an average of 24% registered a difficult to understand dramatic increase to an average of 75% in the post test. Part of this could have been unfamiliarity with the feedback devices during the pre-test and partly by the unfamiliar nature of the questions even though we replaced American names with Indian names. The topic plans made no attempt to follow the cues presented by these questions so the jump was surprising.
- These results led us to the belief that if these were true then it should be reflected in a general increase in understanding which should manifest itself in the schools own testing. We

therefore asked the school for the results of the school's end of term tests. The results of that exercise are explained in Section 11.4

11.3. The embedded questions

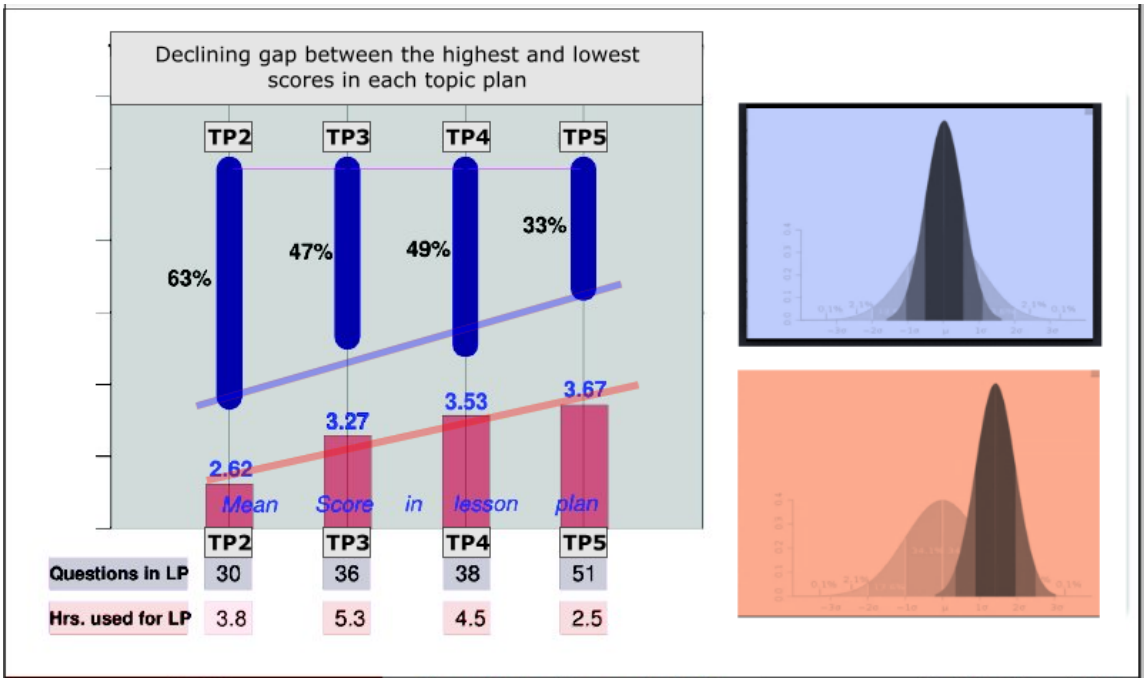


Figure 8: Analysis of embedded questions in the topic plans

11.3.1. Observations

- Figure 8 shows in the upper histogram the gap between the highest and the lowest scores in each of the topic plans 2 to 5. This was done by assigning 100% to the best scorer in each topic plan and then obtaining the percentage for the lowest score. The declining gap is equivalent to reducing the range of variation in the bell curve.
- In the lower histogram we see the the average class scores on a scale of 1 to 5 of the experimental group for each of the Topic Plans 2 to 5.
- The trend line is an improving one and is equivalent to a shift of the mean of the bell curve to the right.
- Please note that this is a very small sample of the population and therefore these test results cannot be extrapolated to the population as a whole. They are merely indicative of what may potentially be achievable.

11.4. The school's end of term examinations

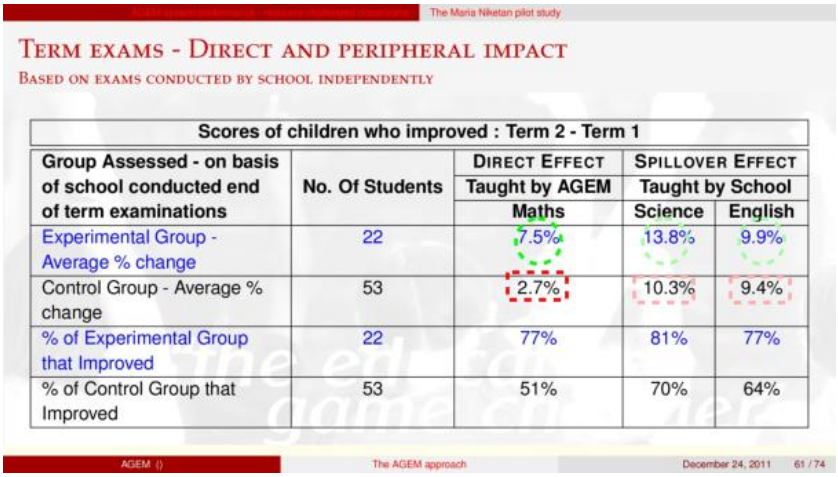


Figure 9: Analysis of end of term examinations conducted by the school

11.4.1. Observations on Figure 9

- This figure takes into account only the children who showed an improved score in the second term i.e. after the end of our course compared to the scores in the first term i.e. before we commenced our course. These exams were totally managed by the school and we have no idea what was examined.
- In the third column from the left the green circle highlights the improvement the taught group achieved while the red circle below it highlights the improvement the rest of the class achieved between the two end of term examinations.
- We note similar differences, though smaller, in Science and English. These topics were not taught by us but it is possible that motivation levels may have risen or the greater level of writing albeit with our feedback devices, and the greater level of engagement in mathematical processes could have contributed.
- In rows 4 and 5 we also notice the enhanced percenatage of the number of people who improved compared to the rest of the class.

12. Sustainability

Sustainability is a function of many parameters which include:

- Acceptance: Any modulating initiative eventually has to have acceptance. That acceptance will at least be partially dependent on the nature of outcomes.

- Nature of outcomes: AGEM's ideas have been implemented only partially so far in various regimes as indicated in Section 10. It is only in the Pilot Study that definitive quantitative outcomes have been obtained and these are explained in Section 11. Outcomes however can also be understood in terms of current systems of evaluation. While we have not subjected our students to Board Examinations, the results of the School end of Term exams at the Pilot School indicated a clear increment.
- Cost of implementation: We believe that we can lower the cost of implementation for two reasons. Firstly, we do not need textbooks. Secondly, hardware costs are declining and feedback devices in the shape of tablets are commercially available for USD 60. These can of course be used across many classes.
- Stakeholder expectations: Stakeholder expectations of government schools are relatively very low at this point in time. Fulfilling such expectations from students, parents, government ministries and school authorities is relatively easy. That process is facilitated by the quantitative measures of performance that characterise the AGEM approach.

Part VI.
Business/implementation model

Our implementation model is based upon a first stage investment of about USD 50,000 for creating validation data. The second stage investment is of the order of USD 500,000 at the commencement of the project and USD 300,000 after 1 year. Return on Investment (ROI) is achieved in the Year 3.

13. Description

Our business model is focused on the public private partnership philosophy that the Govt. of India is beginning to pursue. Our processes are improved by the greater ingress of data for analysis not only in identifying weakenesses on the school side but also in identifying how to make our systems more powerful on the AGEM side.

14. Nature of business model

Our business model visualises the delivery of learning services to students of subscribing schools in the Grade 6 to 12 segment. These will require in the longer run the following structure in the time order of the sequence cited:

14.1. Cost Centers

- Development center: This will generate the topic plans and modify them on the basis of reports from the Data Center. It will also be responsible for the development/transfer of new technologies e.g. sensor technologies to make K12 education a richer experience.
- Data Center: This will receive, archive, and analyze all data received from student responses. It will work closely with the Development Center to generate improved materials for learning. It will also provide guidance to schools where student performance has sharply declined or improved or where there are early indicators of physical or mental health evident from student responses. Schools can then investigate matters in greater detail.

14.2. Profit Centers

- Certification Center: This will use archived data to certify the performance of students, teachers and schools. It will also generate a School Performance Index for subscribing schools and will advise schools on ways to enhance the School Performance Index through the Consulting Center. Additionally it will offer AGEM teachers certificates to those who complete an AGEM Teachers course. It will offer additional services to former students to permit potential employers to quiz records for evidence of specific talents.
- Lecture theater: As our systems benefit from large numbers in the audience, the Lecture theater will permit upto 100 students to receive free instruction and thereby allow AGEM to do initial testing of new materials.
- Consulting Center: This will build a knowledge base for enhancing educational institutions through collaborating with the Data Center to identify and integrate learnings from the repository of student performance data. This unit will also offer training to teachers for a fee.
- Annual Maintenance Contract Center: This will be an outsourced activity which will charge USD2000 per year per AGEM classroom of 50 seats.

15. Launch phase - 3 months

The is the validation phase where the investor funds a limited bus based operation to about 100 students divided between 2 schools for a total period two months. In this case:

- A bus is used to take an experimental group of 50 as a subset of Grade 6 from each of 2 schools.
- The bus contains the needed infrastructure to accomodate 50 students
- On three days a week students are taught for 1 hour each on English, Maths and Systems Thinking. This makes it 9 hours a week and 72 hours in two months.
- Students undergo a pre and post test in each subject both for the experimental group and a control group.
- All data gathered is sent both to the AGEM server and a participating Education department of a University.
- At the end, all data is analysed both by AGEM and the participating University and separate reports are forwarded to the investor.

16. The scaling phase - 3 years

During this phase, our systems will be provided to Govt. Schools at USD72 per year for three subjects. Schools will gradually migrate for having the AGEM system as a supplementary activity to one where it supplants mainstream classes for Grades 6 to 8 in English and Maths. At the end of that period there will be a cohort of students with three years experience of AGEM methods entering the School Board examinations process. By that time we expect they will be ready to take Grade 10 examinations in the topics covered. It is our hope that schools will permit us to extend into the Grade 9-12 segment after viewing the performance over 3 years.

17. Sustaining the design - 3 to 5 years

17.1. All India coverage

While our home state of Karnataka is likely to be the first region where these services are offered, these will be extended to all India coverage after 3 years. At that time, novel technologies e.g. cloud servers and others, will be available for distribution of content and wider coverage at low cost.

17.2. Markets and strategy

The data below has been obtained from the publication Statistics of School Education, 2010-2011.[1]

17.2.1. Number of schools in Karnataka and India

Type of School by ownership	Karnataka	India
Govt. Schools	4675	40220
Municipal or ULB schools	51	10921
Private aided	3367	30755
Private unaided	5354	46474
Total schools	13447	128370

Table 1: Number of High/Secondary schools

17.2.2. Number of Students in Grades 6-8 in millions

Grade	Karnataka	India
Grade 6	1.0 m	22.0 m
Grade 7	1.0 m	20.6 m
Grade 8	1.0 m	19.5 m
Total students	3.0 m	62.1 m

Table 2: Number of students in High/Secondary schools

17.2.3. Marketing strategy

The following constitute elements of the marketing strategy

- Government schools: These represent a substantial market with a single point of sale per state. However, there are difficulties in dealing with government, particularly with large delays in payment which can create cashflow crises.
- Private schools: The fees sought by AGEM are relatively small for private schools. We have made presentations to 3 private schools and have had agreement at rates higher than those suggested here for government schools. However, each school is a new marketing challenge and we found only owner principals had the ability to take decisions. These represent a small minority of schools.
- Bus services: These provide a mechanism for serving a greater number of schools in the initial phase in a more salubrious environment for what is likely to be a more productive experience. It is possible that this could be used to provide private schools with a taste of the system prior to their adoption in the mainstream studies.

17.3. Reduction of cost

As the cost of technology declines, it will be possible to lower the cost of operation, delivery and maintenance. Part of this reduction of cost and improvement will come from new technologies for communication. Bandwidth will increase and costs will decline.

Similarly, the cost of generation of content will decrease over time as most of the effort will be directed at tuning content against the evidence from very large student responses.

However, as new disciplines are catered for it will be possible to recover those costs from additional revenue generated by the additional services offered.

17.4. Generation of revenues

Currently, generation of revenues will derive from:

- One time registration fee per student of USD20
- Fee per student per year - USD 2 per subject per month with a minimum of 3 subjects i.e. USD 72 annually
- Annual Maintenance Contract: USD 2500 annually per classroom.
- Teacher training courses: USD 160 for a one week course.

17.5. Partnerships

The following partnerships are envisaged:

- Large scale hardware manufacture in East Asia
- Existing maintenance organization with All India footprint.
- Education department of accredited University for collaboration in research and development.

17.6. Revenues and profits

At the fees cited, assuming 50 students per AGEM classroom, ROI is achieved in 3 years with 464 classrooms in 60 schools. In 5 years we expect to cover 200 schools averaging 9 AGEM classrooms per school offering 4 subjects to generate an operating profit of USD 30 million.

18. The pedagogical perspective

The pedagogical perspective can be obtained from several different directions.

18.1. The McKinsey perspective - Poor to Fair

On the one hand, we have looked at McKinsey's work on educational systems that improve and the characteristics of that improvement process. We believe our approach is consistent with the "poor to fair" journey that has been described. There are additional elements cited there e.g. providing visiting Coaches. Currently that is not easily applicable to India for as Einstein is reputed to have said, "The mindset that created the problem cannot be the mindset that solves the problem" and where do we get enough people with a mindset that has not been shaped by the current education system.

18.2. Bloom's taxonomy

We have endeavored to match the requirements of Bloom's taxonomy with our project as part of Assignment 4. If you have access to the Internet you can view this by clicking this link.

18.3. Howard Gardner's Five Minds for the Future

We have taken from the website for Howard Gardners "Five Minds for the future" concise summaries of each of these five minds.Click here

18.3.1. The disciplinary mind

The mastery of major schools of thought, including science, mathematics, and history, and of at least one professional craft.

The AGEM perspective AGEM's belief is that each child has a gift and it is the duty of the school to help the child identify, expore, nurture and develop that gift. We seek to use the data we capture to identify the child's gift. In that way, we hope to be able to help students identify the discipline that has the potential to provide them the most fulfilment. Our program encompasses Mathematics and our work on Systems Thinking draws on the way in which thinking in systems terms helps us gain better insight into systems across disciplines from fiction to science to history.

18.3.2. The synthesizing mind

The ability to integrate ideas from different disciplines or spheres into a coherent whole and to communicate that integration to others.

The AGEM perspective The introduction of Systems Thinking which at the simpler end deals with understanding and developing behaviour-over-time graphs, and at the complex end deals with System Dynamics models inculcates in students the ability to structure information and create simulations which are subsets of reality. The conversations that must arise within the group when modeling a systems problem forms a medium to explore, communicate and revise one's thinking.

18.3.3. The creating mind

The capacity to uncover and clarify new problems, questions and phenomena.

The AGEM perspective Within the AGEM system, there is a focus both on decision making and on reflection of how the class responded to the question. In doing so we hope to sow the seeds of creativity.

18.3.4. The Respectful Mind

Awareness of and appreciation for differences among human beings and human groups.

The AGEM perspective Part of the discussion that is generated from the representations, particularly where we are showing the analysis from different perspectives, is designed to stimulate discussion between different sub groups of the class. We hope that in doing so students will be able to understand others point of view and learn to respect those perspectives.

18.3.5. The Ethical Mind

Fulfillment of one's responsibilities as a worker and as a citizen.

The AGEM perspective Many aspects of democratic thinking will form the context for the materials that will comprise the lesson plans. Ethics and Morality are essential elements of the mechanisms for developing sustainable communities.

18.4. Scaffolding and Differentiated learning

Vygotsky's Zone of Proximal Development, Csikszentmihalyi's concept of "flow" and K.W. Fischer's thoughts on the need for a suitable lead between what is known and what is taught, lead us in the general direction of scaffolding and Differentiated Learning.

Differentiated learning is difficult in practice because learning by small steps in conventional practice causes boredom for those who learn faster. In the AGEM system the constant stream of questions that students answer has so far precluded tendencies to boredom, thereby ensuring that learning can proceed in small steps. These small steps are accompanied by a visible approach to learning as well as describing the thinking process of the teacher.

Scaffolding occurs in two ways. Firstly, the approach to the generation of Topic Plans is designed to facilitate scaffolded processes, and secondly, the role of the teacher is to complement those processes. Currently, we have not experimented with a separation of these roles, but we look forward to that opportunity in the future.

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