Indo-US Workshop on Peer-Reviewed Online K-12 (10+2) Science Education (PROKSE): A Feasibility Study

NEERI, Nagpur, India, July 17-20, 2003

REPORT

The above referenced workshop jointly organized by the Centre of Mathematical Modelling and Computer Simulation, Bangalore, India and the State University of New York at Buffalo, USA was held at the National Environmental Engineering Research Institute, Nagpur, India from July 17-20, 2003. The list of participants and schedule of work is given in Annexures 1 and 2.

1. Objectives and Motivations of the Workshop

- The proposal was aimed at creating an alternative learning system capable of achieving Universal scientific literacy in India and beyond by exploiting the synergy between evocatively designed learning materials and the rapidly expanding internet. Scientific literacy, as internationally recognized today, is the capacity to use scientific knowledge to identify questions and to draw evidence based conclusions in order to understand the natural and designed world and help make decisions about changes wrought by human activity. Ideally, by the age of 15, all children should be able to demonstrate knowledge and understanding of scientific concepts to recognize rationally investigatable questions and to identify evidence needed for drawing, evaluating and communicating valid conclusions, as well as attaining requisite quantitative abilities to pursue advanced courses in science by those interested.

- Various attempts addressing this objective are under way in several countries. It was felt that the above exercise could be reassuringly conducted by exploiting the experiences gained by the US and Indian endeavors in this area. The immediate motivation for the proposal was provided both by such ongoing endeavors and the current trends of information and communication technologies in the developing world, which are bound interconnectivity throughout the globe over the next two decades.

- Accordingly, a list of participants was drawn up with the above conditions in mind, to include individuals both in the US and India involved in the development of learning materials as well as those experimenting with new communication technologies.

2. Structure of the Workshop:

- We organized presentations on current activities in the development and testing of learning materials, and in the distillation of ideas towards achieving the goals of the feasibility workshop.

- Extended brainstorming, discussion and criticism of critical philosophical and implementation issues led to the articulation of a set of desirable conditions to be satisfied by the structure and content of the learning materials as well as those for its evaluation and impact assessment.

- The seminal ideas were finally integrated to form the substance of a feasible proposal.

- Projectisation of the proposal

3. Recommendations:

- The following parameters were recommended after a detailed consideration of the desirability of demonstrating the creation of a peer-reviewed learning system within a period of 2 years:

- That the first effort should concentrate on the development of learning material for **one** selected theme (see Annexure 2) for the middle school level (standards 6-8). The AAAS ATLAS for Scientific Literacy should prove as an instructive resource base for illuminating the connectivities within the conceptual space.

- That in the first instance this effort should include sufficient elements to enrich the understanding of teachers who would be the primary mediators in the transaction of the learning materials to the students.

- That the first phase material be prepared in English and in Hindi.

- That the core materials be developed in script form, and that a selected segment be developed for online and CD formats.

- That pretest and post-test analyses be conducted to evaluate the effectiveness of the material and for planning further development

4. Project Formulation:

On the last day of the workshop, a project was formulated in pursuance of the above recommendations (Annexure 3). It is proposed to send this document to all participants as to those who have been involved in various stages of planning this workshop for comments and criticisms. We expect to be able to finalize this proposal in the light of comments and criticisms received by the end of September 2003 and thereafter send it to possible agencies for funding for its implementation.

5. Acknowledgements

We acknowledge support from the Indo-US Science and Technology Forum for making it possible to conduct the workshop. We thank to Dr R.N. Singh, Director, NEERI and his staff members for providing the facilities of the institute and its guest house. We thank Dr. G. Prathap, Scientist in Charge, CMMACS for its role in the organization of the workshop and subsequently in the development of a web portal. We acknowledge financial assistance in the form partial travel support to S. Sen from State University of New York at Buffalo, USA. We acknowledge the valuable contributions made by the participants to the outcome of this workshop.

Annexure 1

Erma Anderson,	National Science Teachers Association, USA
Al Byers,	National Science Teachers Association, USA
Sushanta Dattagupta,	SN Bose National Centre for Basic Sciences, Kolkata
Suvendra N. Dutta,	Harvard University, USA
Vinod K. Gaur,	Centre for Mathematical Modelling, Bangalore
J.V. Joshi,	Bhabha Atomic Research Centre, Mumbai
Raziya Husain,	School Science Teacher, Nagpur
P.J. Lavakare,	Manipal Foundation, Bangalore
Irving Lerch,	American Physical Society, Washington, USA
Arabinda Mitra,	Indo-US Science and Technology Forum, New Delhi
Rintu Nath,	Vigyan Prasar, New Delhi
Sanjay Prakash,	Development Alternatives, New Delhi
Sriram Ramaswamy,	Indian Institute of Science, Bangalore
Vinod Raina,	People's Science Network, New Delhi
Anita Rampal,	Department of Education, Delhi University, Delhi
Kana RoyChaudhuri,	Science Teacher/School Principal, Nagpur
Srikanth Sastry,	J. N. Centre for Advanced Scientific Research, Bangalore
Surajit Sen,	Dept of Physics, State University of New York at Buffalo, USA
K.M. Sunder,	Dept of Chemistry, Indian Institute of Technology, Madras
J. Shankar,	Azim Premji Foundation, Bangalore

Annexure 2

AGENDA for the PROKSE WORKSHOP

July 17, 2003 DISCUSSION PHASE

1:30-3:00

Welcome and Opening Remarks
1:30-1:40
R.N. Singh, Director, NEERI
1:40-1:50
A. Mitra, Indo-US Science and Technology Forum
1:50-2:00
V.K. Gaur, IIAp/CMMACS
2:00-2:10
S. Sen, SUNY-Buffalo

2:15-3:00
Plenary Lecture
I. Lerch, APS, Internetization and Science Education
3:30-5:00
Discussion Period

3:30-3:50
E. Anderson, NSTA, Curriculum Development and Scientific Literacy
3:50-4:10
J. Shankar, Azim Premji Foundation, Computer aided interactions with school teachers and students
4:10-4:30
S. Dattagupta, SNBNCBS, Science Education, Philosophy of Science Education
4:30-4:50
S. Ramaswamy, IISc, Science education in India: is net-based learning relevant?
4:50-5:10
Anita Rampal, DU,
Experiments in Content Development

5:30-7:00
Discussion Session - Chaired by V.K. Gaur

July 18, 2003 DISCUSSION PHASE (CONTD)

9:45-10:00
Coffee

10:00-10:20
V.K. Gaur, IIAp, A Universal Syllabus with Minimal Borders
10:20-10:40
P.J. Lavakare, Manipal Foundation, Involvement of Manipal in the field of education at the school level
10:40-11:00
Vinod Raina, People's Science Network,
Impact Assessment and Evaluation
11:00-11:20
R. Nath, Vigyan Prasar
Vigyan Prasar Programmes
11:20-11:40
S.N. Dutta/Eric Mazur, Harvard U, Peer Instruction in a Different Context
11:40-12:00
A, Byers, NSTA, Online Learning and Digital Libraries

1:30-2:30 Round Table Discussion Session – Chaired by I. Lerch

3:00-3:20
K. M. Sunder, IIT, Madras, National Programme on Technology Enhanced Learning for Engineering Education
3:20-3:40
J.V. Joshi, BARC
Teaching Science to Rural Children
3:40-4:00
Sanjay Prakash, Development Alternatives, TARA Gyan Project
4:00-4:20
S. Sen, SUNY-Buffalo
Online Education in Physics: Digital Libraries and Beyond

5:30-6:30 Round Table Discussion Session – Chaired by V. Raina

July 19, 2003: DEFINITION OF PROPOSAL PARAMETERS

10:00-12:30
Round Table Working Session – Chaired by A. Byers
2:00-4:00
Round Table Working Sessions – Chaired by S. Sen
5:00-7:00
Round Table Working Sessions – Chaired by J. Shankar

July 20, 2003 PROJECT FORMUALTION

10:00-1:00
Round Table Working Sessions – Chaired by R. Nath
Closing Statements

Annexure 3

A PROPOSAL FOR OBTAINING FINANCIAL ASSISTANCE FOR THE DEVELOPMENT OF INTERACTIVE LEARNING MATERIAL TOWARDS MEETING THE OBJECTIVES OF PROKSE – Peer-Reviewed Online K-12 (10+2) Science Education

1. Objectives

Towards Achieving Universal Scientific Literacy in India and Beyond:
Scientific literacy is the capacity to use scientific knowledge to identify questions and to draw evidence based conclusions in order to understand the natural and designed world and help make decisions about changes made to it through human activity. Ideally, by the age of 15, all children should be able to demonstrate knowledge and understanding of scientific concepts to recognize rationally investigatable questions and to identify evidence needed for drawing, evaluating and communicating valid conclusions, as well as attaining requisite quantitative abilities to pursue advanced courses in science by those interested.

Teacher is the critical point for transaction to the students. So we believe we will be able to achieve this literacy by giving teachers the kind of activity that will help to achieve literacy

2. Motivation and Ground Work

Brief statement about PROKSE workshop and copy of report as Appendix I

3. Duration:
PROKSE Phase 1 (2 years)
Development of the script for a chosen theme, development of audio and video components and attendant research:
(a) Script development
(b) Multimedia development
(c) Online material development of part of the script (Rintu Nath, J. Shankar)
(d) CD material development (J. Shankar, Al Byers, Suvendra N Dutta – expert on this matter)

4. Deliverables of PROKSE – Phase I
Online learning material on one selected theme from the curriculum of grades 6-8 in English and Hindi (contents approximately of 12 hours of instruction time).

5. Approach

(a) Definition of desired knowledge space for understanding and exploration of the physical, chemical and biological world (see Appendix 2: Contents)

- Space & time scales
- Contents of the universe
- Processes and phenomena
- Energy and transformation
- Structure and forms of matter
- Form and function
- Science in everyday life

(includes creating the scientific world view, relation with technology and society and understanding of systems and environments for creative lifestyles)

- Symmetries and patterns in the Universe
- Evolution
- Revolutionary ideas in science
- World of mathematics

(b) Designing an effective architecture of the conceptual matrix (ensuring requisite depth)

Examples: Challenging Curriculum Criteria; AAAS Atlas of Scientific Literacy (http://www.aaas.org/project2061)
Appendix II: Map

(c) Application and design of evaluation and peer-reviewed methodologies and their operation at every stage of PROKSE.

6. Implementation – Phase I (2 years)

(a) The first designed product will focus on a selected theme for Grades 6-8.
The pedagogical content knowledge will be developed with the help of gifted individuals (scientists, teachers, students, designers and web developers). Requisite materials will be developed for teacher enrichment.
(b) The first phase endeavor will be in English and Hindi. In parallel or subsequently, versions are envisaged in other regional languages through partnerships notably with Azim Premji Foundation (APF), Manipal Foundation.
(c) Steps
(i) Identification of working group(s)
(ii) Select theme(s):
Energy and transformation;
Structure and Forms of Matter;
Revolutionary ideas in science (resource bases in AAAS, TIFR-HBCSE)
(iii) Definition of Curricular Templates (introductory question to motivate the material, teasers with animation, interactivity, etc.) in Grades 6-8.
(iv) Detailed Structure of the Material (peer reviewed)

(v) Script development – first draft (peer reviewed)
(vi) Evaluation and final draft
(vii) Workshops for local coordinators in regions of deployment to refine the developed material
(viii) Prototyping and Pilot Field Testing via interaction with limited group of Teachers in DIETs and Students in classroom environments
(ix) Continuous feedback loops (via online and email vehicles) from students and teachers for material refinement
(x) Development of Tested Product in CD form and in Online form
(xi) Assessment through control (non-user student) groups and PROKSE student users for impact evaluation (pay close attention to the kinds of questions that PISA has)
(xii) Widescale Dissemination/Release (Teacher interaction) by the last quarter of Phase-1
(xiii) Post test given to control group and parallel test to PROKSE users for impact evaluation
(xiv) Feedback analyses and directions for further refinement

7. Organization
(i) Identification of the web portals
(ii) Identification/appointment of a Chief Coordinator
(iii) Creation of infrastructure facilities for coordination (office, communication equipment, computers and staff)
(iv) Acquisition of requisite software

8. Talent Resource: Volunteer scientists, teachers and students

CMMACS, JNCASR and IISc Bangalore, IIT-Madras, Delhi University, People's Science Network (~ 1500 teachers), Homi Bhabha Centre for Science Education - TIFR, Bhabha Atomic Research Centre, Vigyan Prasar, Azim Premji Foundation, Manipal Foundation, SUNY-Buffalo, Harvard University, National Science Teachers Association – USA

9. Requirements (costing to be estimated at a later stage)

(a) Staff:
(i) Chief Coordinator
(ii) Regional Coordinators (2)
(iii) Scientific/technical staff (6)

(b) Office:
(i) Office space (to be rented/leased for the duration of Phase I of the project).
(ii) Office equipment

(c) Computer and communication systems

(d) Operational Expenses:

(i) Stationery Materials
(ii) Product development material
(iii) Utilities, Services, Maintenance and Contingencies
(iv) Travel expenses for coordination, workshops and development activities
(v) Consulting/Professional Services