An Overview of the Development of Learning Standards for Science and Mathematics Education: KG – 8

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Significance and Objectives of Study

Learning Standards are a set of clear statements broken up class and subject-wise specifying the key educational objectives that must be achieved by students at that stage in that subject. They seek to answer *what* must be learnt, sometimes covering a bit of the *why* in the process, but leaving the *how* (and even the details of the *what*) to the school or the teacher.

India does not have a comprehensive Learning Standards document. The NCERT-developed Minimum Levels of Learning (MLL's) are often considered as the graded learning expectations for schools in India. The MLL's are framed in such a manner as to be mechanistic, mentioning highly specific, fragmentary learning objectives in terms of observable behaviour while ignoring the underlying understanding desired (The Great Indian Tradition - Padma M. Sarangapani).

The goal of the current project was to identify, understand and bridge some of these gaps, and to develop Learning Standards (for Science, Mathematics, Social Studies, English and Hindi) that ensures a minimum quality by clearly specifying expectations, while reducing ambiguity and disparities between schools and regions.

Research Design and Procedure

The project consisted of two exercises – (1) a comparative study of Learning Standards and other

curricular documents of various countries and the Indian Boards of Education and (2) framing of Learning Standards.

1. Comparative Study

In the process of designing Learning Standards for KG-8, a detailed review of what other countries do in K-8 education with what is being done in India was carried out by analyzing the curricular documents and textbooks available.

List of Countries Selected for Detailed Review		India
Science	Mathematics	
Canada(Ontario) Singapore United Kingdom USA (NSES & Virginia)	Japan Singapore United Kingdom USA(NCTM & California)	NCERT Framework; MLL; CBSE , ICSE (Anglo–Indian Board),and syllabus documents of various State Boards

The purpose of this exercise was three-fold. (1) to understand what children of other countries learn and are able to do (2) to consider what other countries consider important to teach in schools and (3) to draw upon the base of study done in other countries that can be used in India.

2. Framing of Learning Standards

An analysis of available concept-age maps, child development theory, curricular theory, common errors and shortcomings in children's thinking and learning were also considered while developing the Learning Standards. The content, structure, and clarity of the Learning Standards have been validated by subject experts. Feedback was obtained from subject teachers from a cross section of schools in India.

Findings

Some of the key learnings from the comparative study:

1. Singapore is unique as compared to other countries studied in that the content in science is organized into 5 themes (subject areas) namely Diversity, cycles, systems, Energy and Interactions.

The National Science Education Standards of USA includes Nature of Science elements into the curriculum.

2. Ontario introduces design as an important component in science learning.

3. Singapore and India's Minimum level of Learning introduces science from class 3 while the rest of the countries studied have science from Kindergarten or class 1.

4. Mathematics syllabus of Singapore does not group topics into strands/ areas of study (like Numbers, Measurement, Geometry, Algebra, Statistics, etc) that run through all the grades, instead handles the topics without such grouping.

Different topics in Mathematics are introduced in different classes across the countries (For example, Alberta introduces 'probability' in Class 1, National Council for Teachers of Mathematics – USA introduces from Pre K- 2, England does the topic from class 3-6 while Singapore handles probability only in class 8).

Some of the core recommendations made in the Learning Standards document:

1. For Science Education

a) The current focus in the Indian curriculum is on teaching facts, and development of *skills* is not being emphasized. Students need to acquire skills necessary for scientific inquiry and the skills necessary for the workplace.

b) The curriculum should emphasize understanding about the *applications* of science and technology in real life, so that students can relate/apply the knowledge acquired for real life solutions.

c) Emphasis should be on making the students aware about the *nature and history of science* (for example, what is currently believed as truth in science may not have been so in the past or in the future).

d) The curriculum should create awareness in students towards the existence of patterns and *unifying concepts* in science, as this will enable them to look at the big picture.

e) It is recommended that some abstract concepts be introduced later than is being currently done (for example, existence of gases is not to be done before grade 4. Young children think of air as 'emptiness' or 'nothing' and find ideas like 'air is a material substance' / 'air is made of gases' difficult to grasp.[1]).

f) Mental health should be included in Biology from grade 2 onwards (for example, children should understand that talking to someone may help people understand their feelings or problems and what to do about them[2]).

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[1] Jayashree Ramadas, Small Science - Class IV, Homi Bhabha Centre for Science Education., p.81
[2] American Association for Advancement of Science and National Science Teachers Association, Project 2061, Atlas for science literacy, p.93

2. For Mathematics Education

a) The goal of Mathematics teaching is to develop in children *mathematical thinking,* teach them *procedures* and also create a *positive attitude* towards Maths. There is a feeling that the current curriculum focuses mainly on the second of these (i.e. teaching Maths procedures). One way of encouraging Mathematical thinking is to build concepts gradually clearly showing the links and patterns underlying different concepts.

b) Students should be taught the *applications of various concepts* so that they are able to apply them efficiently and effectively in everyday life.

c) Increased emphasis should be laid on '*problem solving*' i.e. the children's ability to tackle problems that are conceptually challenging and which have not experienced before.

d) *Fraction operations should be de-emphasized and decimal sense strengthened* as that is what is used mostly.

e) Emphasis on *mental maths* (precise calculation mentally) and *estimation* (rough calculation) skills, *visual and spatial skills* (understanding symmetry and shapes) should be increased.

f) The basics of *statistics* should be introduced early.