Skill Development in Science through Open and Distance Learning

NETAJI SUBHAS OPEN UNIVERSITY
SCHOOL OF SCIENCES

7th October, 2015

Ramesh Sharma
Distance Education

- Method of teaching learning at distance
- Transactional Strategies
- Self-directed learning systems
Distance ... Technology ...

https://internationalstudyabroad.wordpress.com/2013/02/16/10-most-popular-distance-learning-universities-in-india/

http://www.tonybates.ca/2012/02/10/is-open-and-distance-learning-the-solution-for-developing-countries/
The condition of science in India: A serious issue

- Truly, the majority of science students are those whose second choice was science. The majority of science stream students at the higher secondary level which is the basic level on which a major decision effecting the whole career is taken, do so to get a chance to go to the various engineering and medical courses. The reason for this is the better job prospects. Here I would like to add a fact that as far my knowledge goes, very few of the academicians who are in science send their progenies to the science fields. The reason is very simple. They do not like their children to face the same problems which they faced in their life. The same reason is applicable to the fact that most of the science graduates lose a year or so on the average in trying their hands at different professional courses. This is the period when much of the scientific temperament and enthusiasm most needed to excel in science gets suppressed. This trend can be verified by the views of the majority of higher secondary boards’ toppers throughout the country. In majority of cases, they dream of only civil services and other professional courses. Importantly, the theoretical science courses in the JEEs get lower priority and even those who opt for them prefer to go abroad. The situation warrants something effective and drastic to be done to raise the rating of science as a career.

VACHASPATI PANDEY
Physical Research Laboratory, Navrangpura, Ahmedabad 380 009
http://www.iisc.ernet.in/currsci/oct25/articles3.htm
Transforming India

Distinctive Profile of a Developed India

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
Transforming India

A nation where the rural-urban divide has been reduced to a thin line.

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
Transforming India

Distinctive Profile of a Developed India

A nation where there is an equitable distribution of, and adequate access to, energy and quality water.

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
Transforming India

Distinctive Profile of a Developed India

A nation where agriculture, industry and the service sector work together in symphony.

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
Transforming India

A nation where education with a good value system is not denied to any meritorious candidates because of societal or economic discrimination.

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
Transforming India

Distinctive Profile of a Developed India

A nation which is the best destination for the most talented scholars, scientists, and investors from around the world.

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
Transforming India

A nation where the best of healthcare is available to all.

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
Transforming India

A nation where governance is responsive, transparent and corruption-free.

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
Transforming India

A nation where poverty has been totally eradicated, illiteracy removed, crime against women and children is absent, and no one in the society feels alienated.

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
Transforming India

Distinctive Profile of a Developed India

A nation that is prosperous, healthy, secure, devoid of terrorism, peaceful and happy, and continues on a sustainable growth path.

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
Transforming India

A nation that is one of the best places to live in and is proud of its leadership.

http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence
we have to transform India in five areas where India has core competence
Five areas where India has core competence

- 1. Agriculture and food processing
- 2. Education and healthcare
- 3. Information and communication technology
- 4. Infrastructure development, which includes reliable and quality electric power, surface transport and infrastructure for all parts of the country including rural and urban areas under PURA
- 5. Self-reliance in critical technologies.

Former President A.P.J. Abdul Kalam

“...India will need 300 to 500 million employable skilled youth and there is a need to completely change the university education syllabus and secondary school education syllabus. Two certificates should be given to students. In schools, one skill certificate and one education certificate and in college, degree and diploma on the expertise acquired. In schools from classes 9 to 12, 25 per cent of the time has to be allotted for skill development programme,”

Speaking on the occasion of third Malti Gyan Peeth Puraskar 2015 in New Delhi
Skill sectors and manpower needed

The Need to Skill - Local & Global Skilled Manpower Shortage

**Local Need:** The 20 high-growth sectors are estimated to face a skilled manpower shortage of 347 million people over the next 10 years just to sustain industry growth.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Incremental requirement (in million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building and Construction Industry</td>
<td>33.0</td>
</tr>
<tr>
<td>Infrastructure Sector</td>
<td>103.02</td>
</tr>
<tr>
<td>Real Estate Services</td>
<td>14.0</td>
</tr>
<tr>
<td>Gems and Jewellery</td>
<td>4.6</td>
</tr>
<tr>
<td>Leather and Leather Goods</td>
<td>4.6</td>
</tr>
<tr>
<td>Organised Retail</td>
<td>17.3</td>
</tr>
<tr>
<td>Textiles and Clothing</td>
<td>26.2</td>
</tr>
<tr>
<td>Electronics and IT Hardware</td>
<td>3.3</td>
</tr>
<tr>
<td>Auto and Auto Components</td>
<td>35.0</td>
</tr>
<tr>
<td>IT and ITES</td>
<td>5.3</td>
</tr>
<tr>
<td>BFSI</td>
<td>4.2</td>
</tr>
<tr>
<td>Furniture and Furnishings</td>
<td>3.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Industry</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Tourism and Hospitality services</td>
<td>3.6</td>
</tr>
<tr>
<td>Construction Material and Building Hardware</td>
<td>1.4</td>
</tr>
<tr>
<td>Chemicals and Pharmaceuticals</td>
<td>1.9</td>
</tr>
<tr>
<td>Food Processing</td>
<td>9.3</td>
</tr>
<tr>
<td>Healthcare</td>
<td>12.7</td>
</tr>
<tr>
<td>Transportation and Logistics</td>
<td>17.7</td>
</tr>
<tr>
<td>Media and Entertainment</td>
<td>3.0</td>
</tr>
<tr>
<td>Education and Skill Development Services</td>
<td>5.8</td>
</tr>
<tr>
<td>Select informal employment sectors (domestic help, beauticians, security guards etc)</td>
<td>37.6</td>
</tr>
</tbody>
</table>

**Total Incremental** 347

**Global Need:** There is also a global shortage of manpower projected and there would be an opportunity for people from India to work overseas.

http://www.slideshare.net/ICTACT/ictact-bridge-2014-skills-for-india-2020-by-mrdilip-hm-chenoy-director-ceo-nsdc
Mobile skill development laboratory

- Make Education System More Skill-Oriented, Says Former President APJ Abdul Kalam

"We have approximately 9,000 schools in Delhi but all of them don't have the same resources. Therefore, I suggest that mobile skill development laboratories should be introduced for the benefit of the students.

"The mobile vans will be ICT enabled and will have the mechanical and chemical engineering set up. There will be a pre-defined schedule for the van and it will cover two schools in a day," he said.
Instructional Design Models and Methods

- Merrill's First Principles of Instruction
- ADDIE Model
- Dick and Carey Model
- Kemp's Instructional Design Model
- Gagné's Nine Events of Instruction
- Bloom's Learning Taxonomy
- Kirkpatrick's 4 Levels of Training Evaluation
- Cathy Moore's Action Mapping

https://en.wikipedia.org/wiki/Bloom%27s_taxonomy
Learning Styles

https://commons.wikimedia.org/wiki/File:Learning_Styles.jpg
The Barometer Story

http://swift.cmbi.ru.nl/teach/B2/LINK/NOOT_87.html
Ernest Rutherford

Ernest Rutherford, 1st Baron Rutherford of Nelson, OM, FRS was a New Zealand-born British physicist who became known as the father of nuclear physics. Encyclopædia Britannica considers him to be the greatest experimentalist since Michael Faraday.

- **Born:** August 30, 1871, Brightwater, New Zealand
- **Died:** October 19, 1937, Cambridge, United Kingdom
- **Notable students:** Niels Henrik David Bohr, James Chadwick, more
- **Awards:** Nobel Prize in Chemistry, Copley Medal, more
- **Doctoral students:** Nazir Ahmed, Norman Alexander, more
Niels Henrik David Bohr

Niels Henrik David Bohr was a Danish physicist who made foundational contributions to understanding atomic structure and quantum theory, for which he received the Nobel Prize in Physics in 1922. Wikipedia

Born: October 7, 1885, Copenhagen, Denmark
Died: November 18, 1962, Copenhagen, Denmark
Influenced by: Ernest Rutherford, Joseph John Thomson, Søren Kierkegaard, Christian Christiansen, Harald Høffding
Awards: Nobel Prize in Physics, Max Planck Medal, more
Science Skills

THE MARTIAN
A MISSION TO MARS. A FREAK ACCIDENT. ONE MAN’S STRUGGLE TO SURVIVE.
Nine Real NASA Technologies in 'The Martian'

http://www.nasa.gov/feature/nine-real-nasa-technologies-in-the-martian
Habitat

On the surface of Mars, Watney spends a significant amount of time in the habitation module -- the Hab -- his home away from home. Future astronauts who land on Mars will need such a home to avoid spending their Martian sols lying on the dust in a spacesuit.

At NASA Johnson Space Center, crews train for long-duration deep space missions in the Human Exploration Research Analog (HERA).
Plant Farm

Today, astronauts on the International Space Station have an abundance of food delivered to them by cargo resupply vehicles, including some from commercial industries. On Mars, humans would not be able to rely on resupply missions from Earth – even with express delivery they would take at least nine months. For humans to survive on Mars, they will need a continuous source of food. They will need to grow crops.
Water Recovery

Reggie maps plants grow in pillows, small bags with a sticking surface containing media and nutrients, to be harvested by astronauts. In 2018, astronauts used the system to grow “Outrageous” red romaine lettuce and just recently sampled this space-grown crop for the first time. This is a huge step in space farming, and NASA is looking to expand the amount and type of crops to help meet the nutritional needs of future astronauts on Mars.

Water Recovery

There are no lakes, rivers or oceans on the surface of Mars, and sending water from Earth would take more than nine months. Astronauts on Mars must be able to create their own water supply. The Ares 3 crew does not waste a drop on Mars with their water reclaimer, and Watney needs to use his ingenuity to come up with some peculiar ways to stay hydrated and ensure his survival on the Red Planet.

On the International Space Station, no drop of sweat, tears, or even urine goes to waste. The Environmental Control and Life Support System recovers and recycles water from everywhere: urine, hand washing, oral hygiene, and other sources. Through the Water Recovery System (WRS), water is reclaimed and filtered, ready for consumption. One astronaut simply put it, "Yesterday's coffee turns into tomorrow's coffee."

Liquid presents some tricky problems in space. The WRS and related systems have to account for the fact that liquids behave very differently in a microgravity environment. The part of the WRS that processes urine must use a centrifuge for distillation, since gases and liquids do not separate like they do on Earth.

NASA is continuing to develop new technologies for water recovery. Research is being conducted to advance the disposable multiﬁltration beds (the filters that remove inorganic and non-volatile organic contaminants) to be a more permanent component to the system. Brine water recovery would reclaim every drop of the water from the "bottoms product" leftover from urine distillation. For future human-exploration missions, crews would be less dependent on any resupply of spare parts or extra water from Earth.

#SpaceVine - Turns out a sphere of floating water makes the ultimate fisheye lens https://t.co/ubcizt8RB
Mars Spacesuit

NASA is working to recover even more oxygen from byproducts in the atmosphere to prepare for the journey to Mars.

Mars Spacesuit

The Martian surface is not very welcoming for humans. The atmosphere is cold and there is barely any breathable air. An astronaut exploring the surface must wear a spacesuit to survive outside of a habitat while collecting samples and maintaining systems.
Science concepts

- 3 major elements
  - Attitudes
  - Processes and Methods
  - Products

http://sherwintieonsciencedeportfolio.blogspot.in/2013_03_01_archive.html
Attitude

- willingness to modify their own views in the face of new evidence.
- respect for ideas of others.
- disposition not to jump to conclusions.
- scepticism for generalisations not based on verifiable (repeatable) observations.
- objectivity by seeking data and information to validate observations or explanations.
- interest and enjoyment in studying the marvels of nature.

http://sherwintieonscienceeportfolio.blogspot.in/2013_03_01_archive.html
Observing skills - process

http://elsaghirsceince.weebly.com/observing.html
Scientific Skills

**SCIENTIFIC SKILLS**

**SCIENCE PROCESS SKILLS**
- Observing
- Classifying
- Measuring and using numbers
- Making inferences
- Predicting
- Communicating

Using time and space relationship, Interpreting data, Define operationally, Controlling variables, Making hypothesis, Experimenting

**MANIPULATIVE SKILLS**
- Using and handling science apparatus
- Maintaining science apparatus correctly and safely
- Cleaning science apparatus correctly
- Handling specimen correctly and carefully
- Sketch specimen and science apparatus

http://sherwintieonscienceeportfolio.blogspot.in/2013_03_01_archive.html
Products of Science

https://www.e-education.psu.edu/geosc10/node/1708


Research Skills

Critical Thinking
- Imagination and Creativity
- Logic and Reasoning
- Conceptual Thinking
- Reflection and Feedback

Problem Solving
- Imagination and Creativity
- Logic and Reasoning
- Data Collection
- Conceptual Thinking
- Reflection and Feedback
- Scientific Experimentation

Analysis
- Data Collection
- Data Analysis
- Reflection and Feedback
- Scientific Experimentation

Dissemination
- Imagination and Creativity
- Logic and Reasoning
- Conceptual Thinking
- Reflection and Feedback

Future Work Skills 2020

While all six drivers are important in shaping the landscape in which each skill emerges, the color-coding and placement here indicate which drivers have particular relevance to the development of each of the skills.

- **Extreme Longevity**: Increasing global lifespan change the nature of careers and learning
  - Trans-disciplinarity
  - Social Intelligence
  - Novel and Adaptive Thinking
  - Computational Thinking
  - New Media Literacy
  - New Media Ecology

- **Computational World**: Massive increase in sensors and processing power make the world a programmable system
  - Design Mindset
  - Cross Cultural Competency
  - Cognitive Load Management

- **Superstructed Organizations**: Social technologies drive new forms of production and value creation
  - Virtual Collaboration

- **Globally Connected World**: Increased global interconnectivity puts diversity and adaptability at the center of organizational operations

- **Sense-Making**: Workplace robotics nudge human workers out of rote, repetitive tasks

- **Rise of Smart Machines and Systems**: Workplace robotics nudge human workers out of rote, repetitive tasks

http://www.iftf.org/futureworkskills/
Sense Making

http://stanford.edu/~cpiech/cs221/apps/deepBlue.html

Social Intelligence

Novel and adaptive thinking

Cross cultural competence

http://www.newahec.org/Cultural_Competency.html
Computational Thinking

http://barefootcas.org.uk/barefoot-primary-computing-resources/concepts/computational-thinking/

https://computationalthinkingk12.wordpress.com/2014/05/07/introducing-computational-thinking-into-your-school/
New Media Literacy

http://www.newmediarights.org/node/13936
Transdisciplinarity

http://www.discovery.edu.hk/curriculum/primary-years-programme/transdisciplinary-teaching-learning/
Design Mindset

http://www.foxmovies.com/movies/the-martian
Cognitive Load Management

http://www.open.ac.uk/libraryservices/beingdigital/objects/63/index.htm
Virtual Collaboration

http://betanews.com/2015/09/30/social-intranet-allows-anytime-anywhere-workplace-collaboration/
THANK YOU