Title: Very low or almost nil exposure to engineering & technology in the early schooling stage is the biggest problem in technology and engineering advancement in rural India and reason for inability to produce contextual technology solutions in rural areas of the country.

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History and Scope

We are situated in Mohgaon, a Tehsil of Mandla district of Madhya Pradesh in India. It is 40 kilometre from Mandla District and constitutes 87 villages and 38 Gram Panchayats. Mohgaon is surrounded by Mandla tehsil towards the South, Mehandwani tehsil towards the North, Ghughri tehsil towards the East, Narayanganj tehsil towards the West. Kanha National Park, Bandhavgarh National Park and Kawardha are the tourist hubs near Mohgaon.

Introduction

This paper explores a live program: the Narmada Valley Avishkar Labs (referred as NVAL in the paper) that aims to expose the tribal population to technology practices at a very early age, the underlying hypothesis being that when education is given a broader and contextual outlook, no one is a first-generation learner. Children respond to the cultural capital, a term that captures all the qualities that are intrinsic to their environment. This paper aims to demonstrate that educationists must integrate the necessary livelihood skills needed to survive with dignity with children's capacity and cultural capital to make for a meaningful learning process for children. This program is being run with support from the Mandla Zilla Panchayat.

NVAL integrates the two factors below:

a) The livelihood skills that are needed for a dignified livelihood
b) The contextual (cultural capital) knowledge of children for which they cannot be called first generation learners.

The benefit of the program and that which the paper is pointing towards is a more flexible yet strong education system that builds on the cultural capital existing with the children, which results in a faster learning cycle and integrating this cultural skill set in a "modified- upgraded" manner to suit future needs for a secure livelihood.

The three major points that the paper will explore in regards to present context are these:

a) The current contextual (cultural) skills that can be built through an intensive experience of the region and the children.
b) Livelihood skills needed in the global market of the future that will see the rise of automated technology
c) Upgrading the cultural capital to make it future-ready

This region has a majority of different tribes that include Gonds, Baigas and Mariyathey who are generally involved in following activities. Livelihood forest dwellers comprising archers and hunter-gatherers, are mainly dependent on forests, farmers on meager landholdings and landless farmers on lands owned by others. So these tribes are mainly dependent on the old-fashioned livelihood techniques as they don't have knowledge or connectivity to technology.

According to Census 2011, literacy ratio in Mohgaon block is 51%. Among males, the literacy ratio is 61% whereas female literacy ratio is 42%. Due to presence of poorly-educated or illiterate people, the need for livelihood generation and development in this region is greater to help people help themselves.

Literature Survey

We did a study of available literature to understand the paradigm of employability better. Nayana Mallapurkar, who is the Program Head for the TISS School of Vocational Education, feels that about 90 per cent of employment opportunities require vocational skills. Only 20 per cent of graduates of the TISS School of Vocational Education get employed. The rest are unable to get suitable employment due to the lack of employable skills. In the present context of globalization, the demand for skilled and multi-skilled workers has increased. Therefore, in the context of developing countries, such as India, there is a critical need for high quality skill development and training. In general, apart from the core subject expertise, some of the prominent employable skills that employers seek are:

- communication skills (verbal and written)
- commercial awareness
- attitude towards work
- lifelong learning
- self-management
- teamwork
- problem solving
- initiative
- self-motivation
- adaptability
- stress management
- creativity
- interpersonal sensitivity
- technology/IT skills

Dr. Lakshmi Mohan who is the campus head of ITM Business School says that at school level, options must be available for skill development courses and they must be provided in the secondary stage of schooling. Many more courses in fields such as hospitality and tourism, handicrafts, healthcare, textiles, photography, IT, retail, banking and insurance can be added that may interest students. For instance, if a student opts for healthcare, he could learn to be a blood-collection expert and later can add further courses to become full-fledged pathology technician or nurse. The pedagogy has to be practical; learning can be enhanced through field visits, e-learning, industry driven projects, digital or video inputs and so on.

As per a study from the latest edition of National Employability Report, Engineers 2014 by Aspiring Minds, only 18.43% engineers are ready to be deployed as software engineers in the IT services industry out of more than 6 lakh who graduate each year. For IT product roles, this number is a staggering 3.21%.

The current paradigm of employability does not consider the notion of cultural capital at all, preferring to equate all youth in the same basket of the unemployed and unemployable. Cultural capital is the accumulation of knowledge, behaviors, and skills that one can tap into to demonstrate one's cultural competence, and thus one's social status or standing in society. The Gujarati and Marwari communities are known for their business acumen since the time business was first introduced here. Today, these communities are known for their diaspora scattered all across the world. Gujaratis are vegetarian and a food-loving people. A traditional Gujarati thali consists of *dal* (lentils), *roti*, rice and vegetables apart from salads, farsan and sweet dish followed by chaas, forms the morning meal. Evening food consists of *bhakri-shak* or *khichdi kadhi*. Most of the small-scale entrepreneurship in Gujarat has developed in the domain of food. Many Gujarati women are involved in food-related entrepreneurial activities. Majority of the Gujarati thrive as business persons as agriculture and livestock sector contribute 17.5 % and 4.5% share in the state's GDP.

Similarly, the Marwari community is from the desert and a lack of natural resources led Marwari people to become businessmen as they refused to resign themselves to poverty. They migrated across the world, thriving on the business opportunities available. According to the Census of 2001, Marwari is a language spoken by 79,36,183 people in India and they are majorly concentrated in the states of Rajasthan, Maharashtra and Gujarat. Most of the Marwaris are either Hindus or Jain. The Marwari cuisine is strictly vegetarian and offers a fabulous variety of mouthwatering dishes. Marwari community was created through trading and capitalist alliances. The Marwari trading networks themselves created the very possibility of a public community.

For the hilly people, serving in the armed forces is a key part of the cultural capital. Indeed, the Indian Army has regiments from hilly states Garhwal Rifles from Uttarakhand, Assam regiment from Shillong, Jammu Kashmir Light Infantry from Jammu, Naga regiment from Uttarakhand, 1 and 4 Gorkha Rifles from Himachal Pradesh, 8 and 9 Gorkha Rifles from Shillong. A recurrent theme across the histories of all of these communities is that they built upon the cultural capital and became big and popular, evolving with time.

Fig 1: An example of a toy car with a precise chassis made by tribal children in Mandla

For a good engineer, we define cultural capital to be the ability to think creatively and innovatively, strong Mathematical and problem-solving skills. For the tribal communities, this cultural capital exists though it needs to be upgraded. In the subsequent paragraphs, we will demonstrate instances of this, as we have observed in our study of the tribal community here.

- Agricultural Engineering tools

The tribal here work on rocky, undulated hilly terrains which are not suitable for commercial farming and still they are able to produce good quality in food crops, some of them ensuring that enough to feed the family is produced. The local carpenter with the help of cutting tools like axe, chisel, ‘basula’ and a planer can cut and make wood cum iron frames and manual equipment for the farmers to plough their farm plots on the rock hilly terrain and do the plough tasks. Also sickles made locally in the village by the blacksmith of the village are used by the farmers at field.

Plough type 1

Wooden structures to mount on the shoulders of the cattle to fit the plough

Plough type 2

- Civil Engineering: The local communities make their own houses with mud and kothi to keep their crops secure. The tribals here make their own houses with soil and logs of strong wood from the forest and most of them practice the repair maintenance work every 5 year period. They also have their big size earthen containers inside the house called as ‘kothi’ to store the grains and protect them from rats and moisture.

There is a type of loamy white soil in the region which is used by the villagers to make the final polish and varnish for their house walls and used to color the walls.

- Water Resource Management and Distribution
  They have undulated land, so they manage the source of water and accordingly make earthen bunds to block and provide water to their farm lands. At some sources of water, there have been seen channels of wood to make a open pipeline system to feed the cattle.

- Conservation along with consumption from the forests making utility things from different types of grass and wood
  The tribal here are mainly dependent on forest and are majorly forest dwellers that bring the resources like fruits, vegetables, fuel-wood and grass from the forest to bring it into consumption and even make utility things out of them. Even in this consumption practice, they are very protective towards their forest. They make a local calorie drink using the process of distillation on the streams' banks or any other water source; a rope is being made since 20-30 years using the long grasses of 'sun' crop and also from other lentils and use it to make knots and tie loads of things like, wood or harvested crop from the field to the home. There is also seen a knitted form of mesh and furniture made from lantana (a local grass) sticks. So the traditional ecological knowledge of the people still ensures access to quality basic tools like a rope.

Rope made from a long grass called 'Sun'

Process of distillation seen in mahua making

- Fence

Fishing Trap Type 1

Fishing Boat made from tree trunk

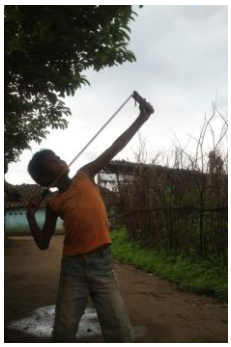
Fishing Boat made from tree trunk

- Mechanical Engineering works and tools developed

  The tribal people are less exposed to high quality tools as there is no presence of advanced machinery or power tools to reduce human labor or work. So they make their own tools with the materials available to them. This art is also the skill set matching the mechanical engineers who design the product and then develop the product or tool upgrading them, tinkering or troubleshooting on new materials or design part without any such technical training on science or orientation.

- Innovators

  There are tribal kids who make their own toys by using waste items, so they have sense of utilizing waste materials and solving their problem of a lack of engaging play material.



It is commonly known that unless children receive sufficient exposure to a discipline, they will not imbibe it. A key finding of the research by the University of Calgary team found that students who take foreign language classes at school are unable to gain deep fluency unless they receive sufficient exposure to the language. "Learning a second language for 95 hours per year for six years will not lead to functional bilingualism and fluency in the second language. Expectations must be realistic," cites the paper. With science and technology education, it is the same.

Methology:

To establish that by the time these children reach Class 10, they lose interest in Math and Science, we studied the data from the Mohgaon Government school. We found that out of 109 students, there are 25% in science, 65% in Arts and 10% in Agriculture.

Our experience of the NVAL program with primary and middle school children indicates otherwise. Indeed, children have not only demonstrated a keen interest in science and Math but they have demonstrated understanding of the usage of a motor and a fan to creatively solve problems in a matter of three months. In three months, students of rural government school children from classes 6 and 7 have responded very well to learning and understanding the concepts and applications as below:

Projects	**Topics of Applied Sciences Covered**
Catapult	Elasticity

Projects	Topics of Applied Sciences Covered
	Newton's law of motion
Soldering Workshop	Basics of Soldering
	Practical sessions
Solar Cooker	Solar Energy
	Renewable Sources of Energy
	Heat
	Absorption of Heat
Electrical Conductivity	Electrical Circuits
	Electricity Conductive materials
Salt Water Conductivity Experiment	Salt water is good conductor of electricity
	Electric Circuit
Smart Almirah lighting system	LED lighting system
	Circuit and Network
	Batteries
Torch (Flashlight)	LED bulbs
	Reflection of Light
	Switches
Motor Boat	Buoyant Forces & Buoyancy
	Archimedes' Principle
Portable Fan	Motors
	Switches
	Circuit Connections

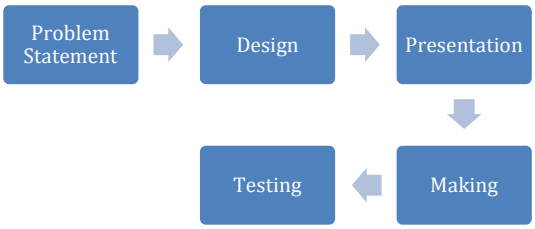


Fig 2: Structure of the NVAL program that typically happens in Government school classrooms in groups of 4 children

Discussion:

As per a report, there were only 44 engineering institutes in India with an intake capacity of 3300 students before independence. This number has increased to 3200 engineering institutes with intake capacity of 16.3 lakh, registering an increase of more than 75 times in institutes and more than 500 times in the intake capacity. There has also been a great progress in nuclear energy, medicines, information

technology and space sciences. But it is an admitted fact that we have not been able to produce many research scholars of international repute and in consonance with our number of institutes and a large population.

In the 116 year history of Nobel Prize, we have so far received only one in 1930 won by C.V.Raman. This compels us to think where the fault lies. The President of India Pranab Mukherjee while addressing academicians and students recently at Rashtrapati Bhavan said, "Lack of conducive environment in academia was pushing the best talent towards regular jobs instead of critical research. We have excellent IITs, NITs and IIMs where campus recruitment is almost 100% but no Indian scholar working in an Indian university has won a Noble Prize since 1930. If they had given the time and energy to do research, the country would have benefitted much more." He has clearly referred to our education system which does not provide the required environment for research. Chandrashekher and Dr. Hargobind Khorana got the Nobel prize only when they shifted their citizenship and work place to America where they had a conducive environment of research. Hence, knowledge and understanding have been subordinated by marks and degrees. Existing education structure has not been able to imbibe a proper scientific culture. This is the reason that for the last some years about 50% of the seats in engineering colleges remain vacant.

Conclusion

On the other hand, 72.2% of the total population is distributed in about 638,000 villages while the remaining 27.8% lives in more than 5,100 towns and over 280 urban agglomerations, making rural India a powerhouse for national development. Since most of India's resources are concentrated in remote areas, by leveraging manufacturing and industry in rural landscapes, the nation can utilize them in an efficient manner. It will reduce the cost of manufacturing that will eventually help end customers. Productivity will increase impacting export and foreign exchange. Hence, these regions will be turned into growth engines to drive the nation towards progress. Thus, it is evident that for science and technology to take off in rural areas, there is a huge need to introduce these disciplines through a hands-on approach among rural school children. It is only through this that the spirit of Make in India will be fully realized.

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