



# Reforms to Strengthen Science Education in the Country with Emphasis on Physics Education

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My Hamirpur experience



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BP can make others learn



# Plan of Lecture



- Education system: A world perspective
- An example: Finland: John Dewey – remodeled
- My experience on Soviet Education System
- Great minds on Indian education: ground realities
- Quantity and governance of government spends
- Covid 19: Aftermath
- STEM education: US and China experience
- Can we come up with a solution???

# Leading education systems

1	Finland	11	Netherlands
2	Japan	12	Belgium
3	South Korea	13	Germany
4	Denmark	14	China
5	Russia	15	Singapore
6	Norway	16	Portugal
7	United Kingdom	17	Hungary
8	Israel	18	Estonia
9	Sweden	19	France
10	Hongkong	20	United States

By yearly poll

Source:<https://www.edsys.in/best-education-system-in-the-world/>

1	United States	11	New Zealand
2	United Kingdom	12	Denmark
3	Germany	13	Norway
4	Canada	14	Italy
5	France	15	Finland
6	Switzerland	16	Austria
7	Japan	17	Spain
8	Australia	18	Belgium
9	Sweden	19	South Korea
10	Netherlands	20	Ireland

Source: [HTTPS://www.usnews.com/news/best-countries/best-countries-for-education](https://www.usnews.com/news/best-countries/best-countries-for-education)

- Finland offers free education to citizens
- They have shorter school days (190 days per year)
- Students are free to choose their educative path
- There are certain core principles underlying the education system of Finland (Ex: John Dewey)

Until the age of 6, students aren't required to attend schools. For next 9 years they follow a single structure education

The Finnish National Agency promotes self-evaluation for both teachers and schools

Finland does not incorporate national standardized testing but they do evaluations for testing learning outcomes.

One of the other striking features is the free meals.

- Education, hostel, medical, books, all free
- Every student gets stipend to meet food expenses and incidentals
- Teacher to student ratio 1:6-8
- Every teacher always available for consultation
- Students divided in groups of no more than 8 students
- Across all universities same syllabus and structure
- Universities and Technical Institutes
- University degree & Ph.D.
  - Preparatory (Russian or other foreign language, basic courses)
  - 5 years integrated (after 3 years specialization)
  - 3 years Ph.D

- Lectures

Several groups of the same batch attend lectures on a specific subject (about 60-70 students)

Common core subjects across specializations

- Tutorials

Organised for each group: problem solving session for each lecture. Generally synchronous with the lectures

- Intensive maths training for physics students for first two and half years
- General awareness: History of philosophy and Science



Students can appear for tests and exams within a stipulated period with start and end date. No timetable for specific exams

- Jachyot (Qualifying test for the exam)

Every student has to prove their problem solving ability in the test to enable him to appear for the exam

- Ekzamen (Examination)

Based on biliyets (question papers) listing three or four topics. One has to pick one out of say 20 papers. One can take time to prepare, finally he has to answer all the questions asked by the professor related to or beyond those topics.

Evaluation is done on the spot (grade) and put in the casebook of the student.

- Students are given elaborate writeups on each experiment and they have to appear for two vivas
- First one to prove that he knows the theory to be tested and he is familiar with the equipments and can operate them
- After clearing the first viva he is allowed to do the experiment and take data and represent them
- The second viva is to check his results and his ability to explain the possible cause of any deviation from theoretical results
- Submission of the lab reports is not necessary

- higher education system is widespread, and while the quality of it is very mixed, there are still a lot of people getting reasonable higher education
- in some fields, especially in technical education, the quality of what is offered is indeed fairly high. Against these "positives" stand the **huge neglect of primary education and also secondary education**, and of course - as already mentioned - **the highly variable quality of university education** (some of it not worthy of that name)



# Amartya Sen on Indian Education: Pitfalls

- Functional handicap, intellectual deprivation, and social disadvantage.
- When large groups are systematically neglected, like girls, especially from economic and social underdog families, the social penalties are gigantic.
- The main causes of our uneven and highly unequal educational system are **not technological underdevelopment but political and social neglect.**

## Education in agency areas a farce?

- Ganella, Araku mandal : Girls Tribal Welfare Ashram Schools (GTWAS)  
(~500 students, 14-17 cots in each room, Each cot is meant for two, but occupied by 4-6 students. with severely inadequate amenities)
- When a sixth standard student of GTWAS was asked to read the name of her English textbook, she hesitantly spelt out the letters of the English alphabet incorrectly. She can't read a single word in English.
- At another GTWAS, there are 21 teachers, but at a given moment 5-6 only are present. PT teacher doubles up as english or math teacher

## Safety at stake !!!!!

- <https://timesofindia.indiatimes.com/city/visakhapatnam/safety-at-girls-residential-schools-in-araku-questionable/articleshow/54383539.cms>



# Amartya Sen on Indian Education: Ways Out?

- The government has to speed things up. However, the **government is not the only agency involved**. Not only more money is needed in schooling - not just through raising salaries of teachers and officials - but also better organisation of teaching and better practices (not minimal schooling with maximal private tuition!).
- We need **cooperation between many agencies**: governments (at different levels), teachers' unions, parent-teacher committees, civil society in general.

# How much the government spends?

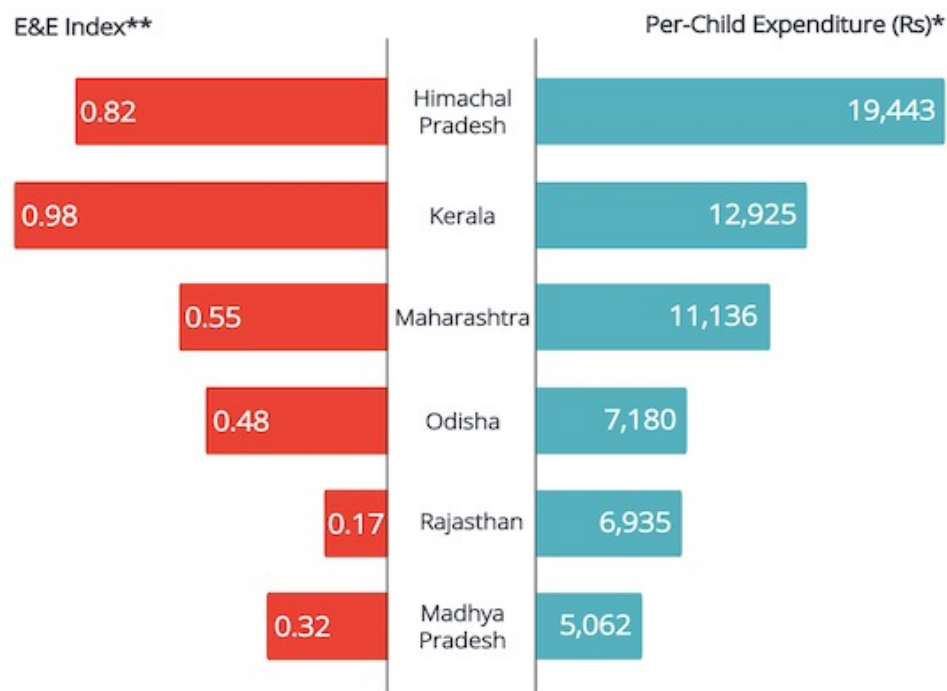
- E&E index and per-child expenditure
- Spending on education down since 2014
- Spending on school education down since 2015
- Expenditure on National Education Mission (Samagra Siksha) vs Funding by Cess

Source:

[https://www.business-standard.com/article/economy-policy/can-india-s-education-budget-fund-increased-spending-in-new-policy-119091000108\\_1.html](https://www.business-standard.com/article/economy-policy/can-india-s-education-budget-fund-increased-spending-in-new-policy-119091000108_1.html)

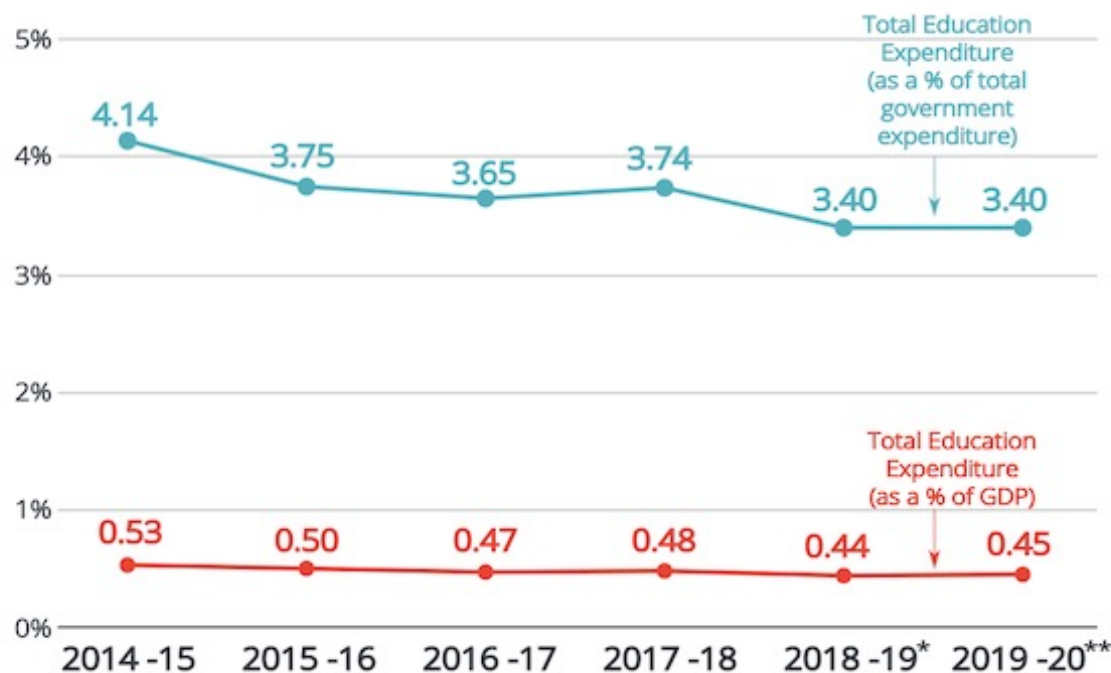
## Education & Empowerment Index & Per-Child Expenditure Of Selected States

States that spent more on education scored higher on the empowerment index





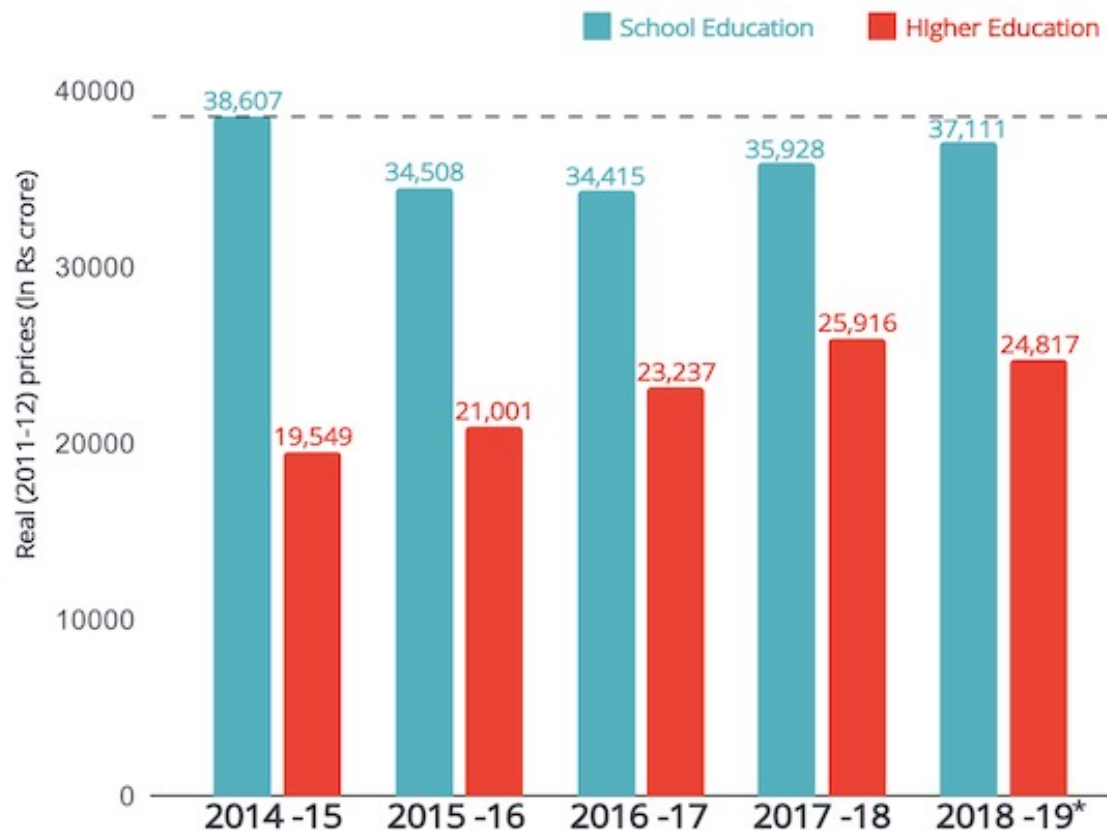
## Spending On Education Down Since 2014



\*Revised Estimates

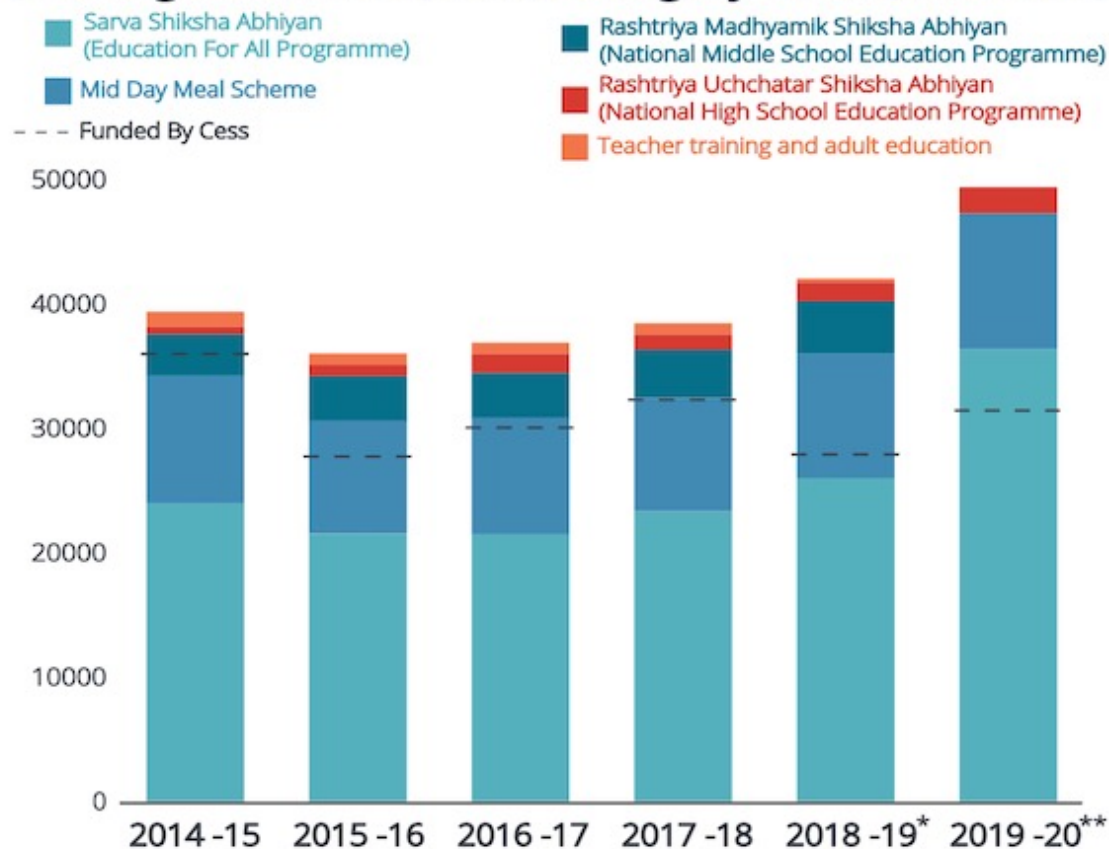
\*\*Budget Estimates

## Spending On School Education Down Since 2015



# Expenditure on National Education Mission (Samagra Siksha) vs Funding by Cess

## Expenditure On National Education Mission (Samagra Shiksha) & Funding By Cess (Rs Crore)



\*Revised Estimates

\*\*Budget Estimates

- The share of the union budget for education fell from 4.14% in 2014-15 to 3.4% in 2019-20
- To match the goal of spending 20% of the country's govt budgets, states would also have to increase their spending. It has decreased though the revenue has increased
- **Government education funding overly dependent on the education cess.**
  - The budgetary support for education expenditure has declined since 2015.
  - the cess has funded 70% of the total education expenditure
  - the cess has become a regular way of funding education expenditure rather than providing the money through a dedicated budget.

State governments have no say or access to this fund. None of these issues are discussed in the education policy



# Why funding could be so very important

## Bloomberg Report (in US context)

- A 10% increase in spending on average
- leads children to complete **0.27 more years** of School, to make wages **that are 7.25% higher**
- Enables to have a substantially **reduced chance of falling into poverty**
- benefits of increased spending **are much stronger for poor kids** than for wealthier ones.

Source: <https://www.bloomberg.com/opinion/articles/2015-01-23/spending-more-on-public-schools-boosts-u-s-economy>

**Table 1: % Children enrolled in school. By age group, sex and school type. 2020**

Age group and sex	Govt	Pvt	Other	Not enrolled	Total
Age 6-14: All	65.8	28.8	0.8	4.6	100
Age 7-16: All	65.5	28.6	0.7	5.2	100
Age 7-10: All	64.3	30.5	0.8	4.4	100
Age 7-10: Boys	60.9	33.6	0.8	4.7	100
Age 7-10: Girls	68.1	27.0	0.8	4.1	100
Age 11-14: All	68.0	27.4	0.7	3.9	100
Age 11-14: Boys	64.5	30.9	0.7	3.9	100
Age 11-14: Girls	71.9	23.5	0.7	3.9	100
Age 15-16: All	62.1	27.3	0.6	9.9	100
Age 15-16: Boys	60.8	29.7	0.8	8.8	100
Age 15-16: Girls	63.6	24.8	0.5	11.1	100

'Other' includes children going to Madarsa and EGS.

'Not enrolled' includes children who never enrolled or are not currently enrolled.

**A notable shift from private to public between 2018-2020**

**REASON: Financial distress / permanent school shutdown**

Source:<http://img.asercentre.org/docs/ASER%202021/ASER%202020%20wave%201%20-%20v2/nationalfindings.pdf>

- Large dropouts of school going children
- A radical change in teaching methods: schools, colleges and universities
- Science education: Lab experiments replaced by video demonstrations
- Powerpoint and Keynote files: can replace black board interactive teaching?
- Online tests and exams: A farce?



- one in nine among 'general' category students.
- In Assam over a third of all students dropped out
- Two states with significant tribal populations, Odisha and MP had the highest proportion of tribal students dropping out at secondary level
- Gujarat and Maharashtra, with sizeable tribal population had over 26% tribal students dropping out

Source:[http://timesofindia.indiatimes.com/articleshow/84161197.cms?utm\\_source=contentofinterest&utm\\_medium=text&utm\\_campaign=cppst](http://timesofindia.indiatimes.com/articleshow/84161197.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst)



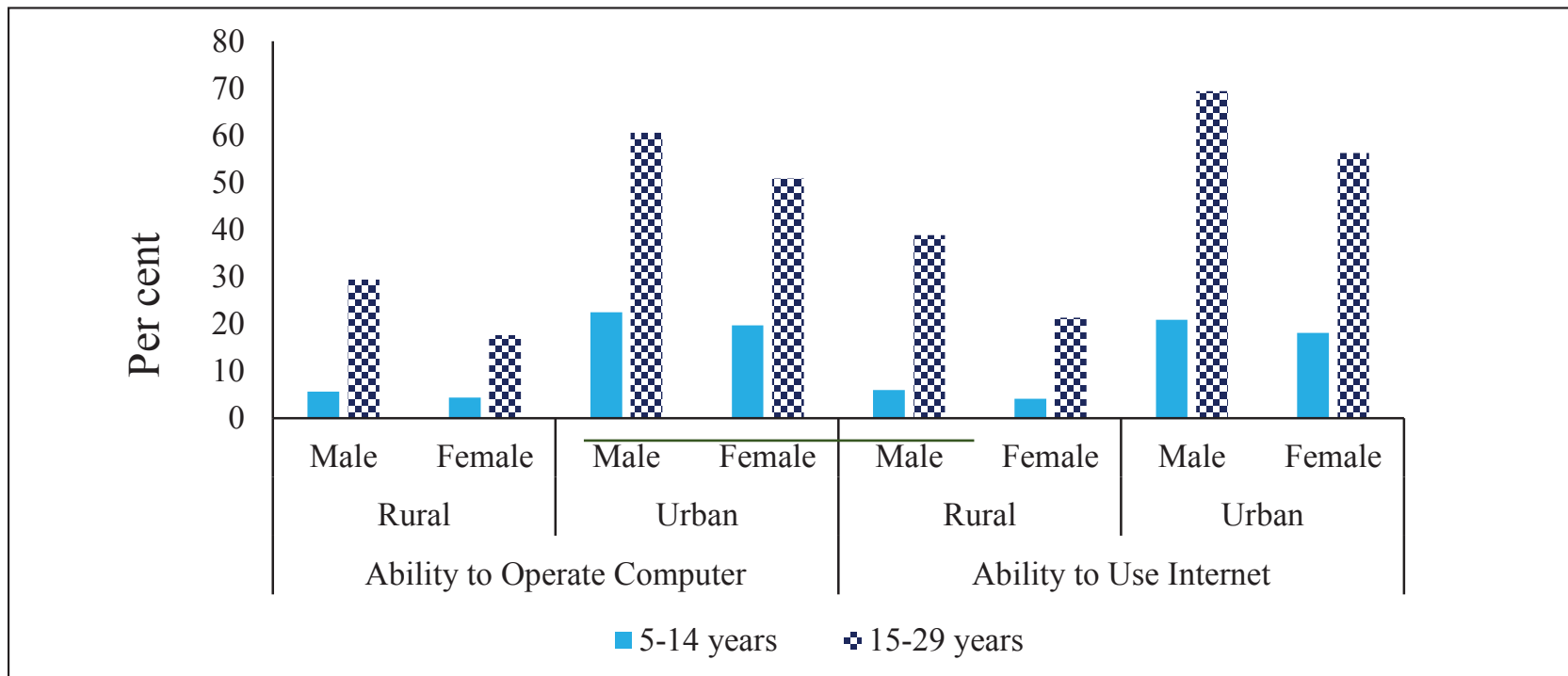
## Programmes and Schemes for School Education during 2020-21

**PM eVIDYA:** This initiative was announced for school and higher education under the Atma Nirbhar Bharat programme in May, 2020

- One nation, one digital education infrastructure DIKSHA
- One class, one TV channels through Swayam Prabha TV Channels: Swayam Prabha DTH channels are meant to support and reach those who do not have access to the internet
- Extensive use of Radio, Community radio and Podcasts:
- For the differently-abled: One DTH channel is being operated specifically for hearing impaired students in sign language.

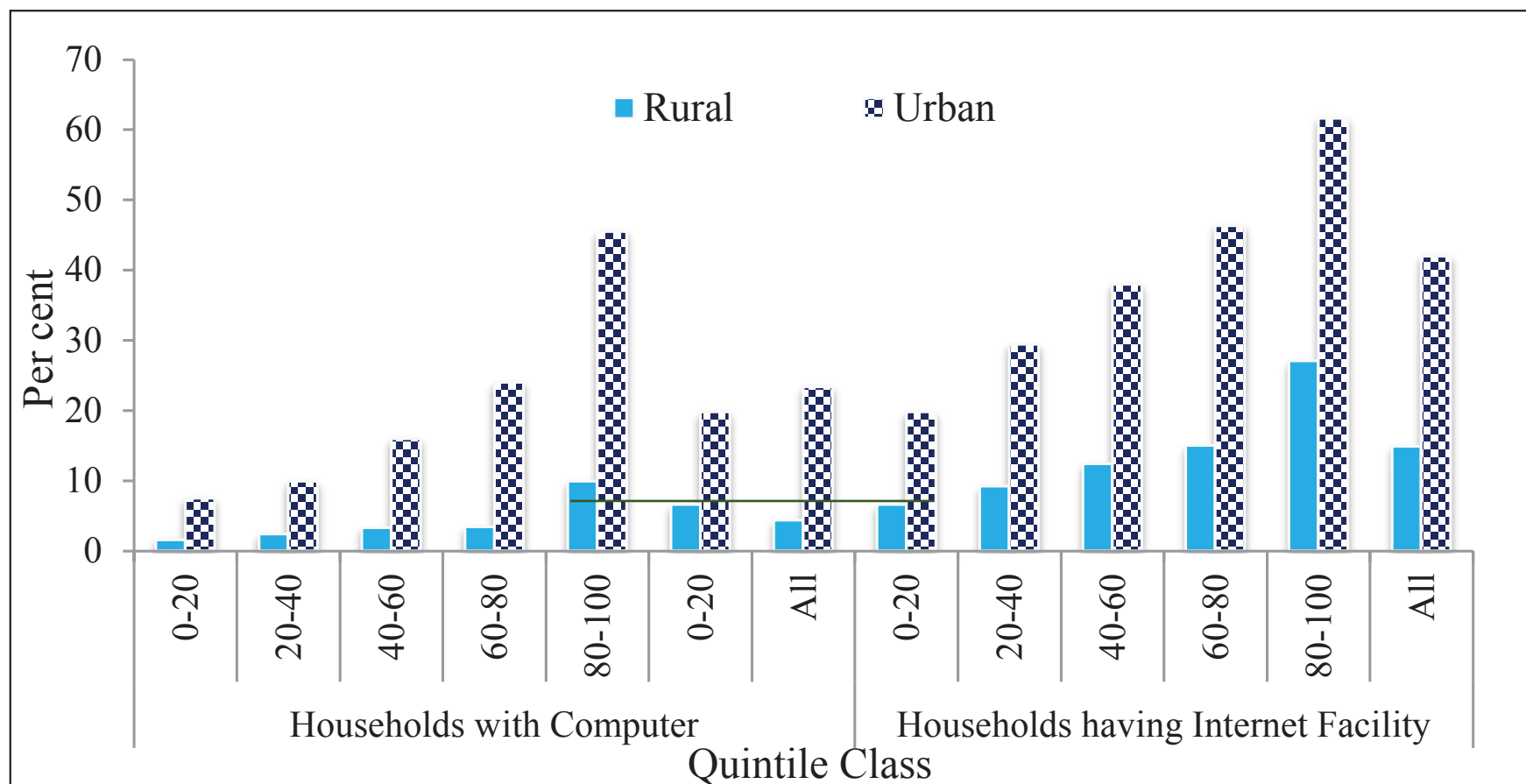


# Persons (age 5-14 & 15-29 years) by Ability to Operate Computer and Ability to Use Internet, 2017-18



Source: NSS Report No.585-Household Social Consumption on Education in India, 2017-18

# Households with Computer and Internet Facility for Each Quintile Class of Usual Monthly Per Capita Expenditure, 2017-18



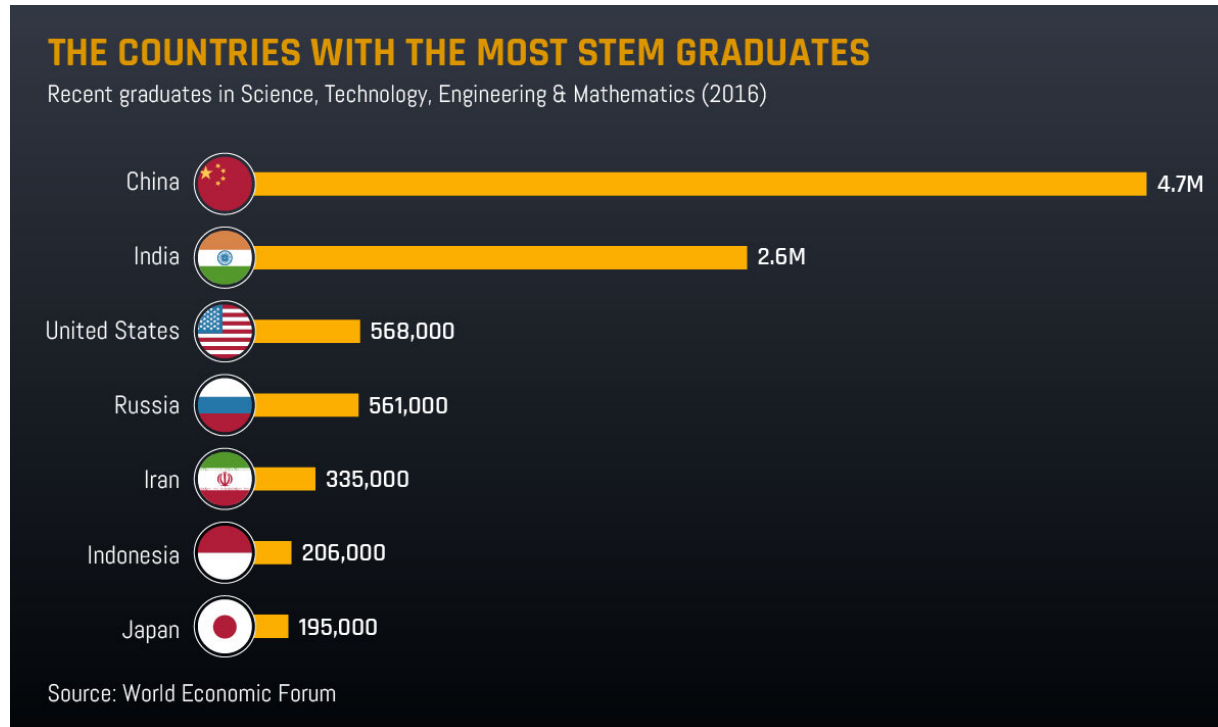
Source: NSS Report No.585-Household Social Consumption on Education in India, 2017-18



STEM stands for Science, Technology, Engineering, and Mathematics.

- This program was started by [Judith A. Ramaley](#), the former director of the National Science Foundation's education and human-resources division.
- It is designed to revolutionize teaching by incorporating technology and engineering into regular curriculum by creating a “meta-discipline.”
- STEM Education attempts to transform the typical teacher-centered classroom by encouraging a curriculum that is driven by problem-solving, discovery, exploratory learning

Year: 2016



STEM graduates per population—1 to 52 in India and 1 to 57 in the United States. However, Still no match for China's 1 to 29 ratio

Source: <https://www.visualcapitalist.com/stem-education-crisis-future-work/>



## Why the Current Education Reform Strategy Won't Work

### Existing: “Some STEM for All” approach

In this view, STEM is so important for individual opportunity that the nation must make sure that all students get as much high-quality STEM education as possible.

This solution would involve raising the quality of STEM teachers from kindergarten through 12th grade

imposing rigorous STEM standards, improving curriculum, and boosting awareness among students of the attractiveness of STEM careers.

Unfortunately, even if all of these steps could be funded—which is not the case, given fiscal realities—they would not solve the problem.



## Should be: “All STEM for some” approach

- the purpose of STEM education is not principally to create economic opportunity for individuals but to provide the “fuel” needed to power a science- and technology-driven U.S. economy.
- The framework will require working actively to recruit those students who are most interested in, and capable of doing well in, STEM
- providing them with the kind of educational experience they need to make it all the way and come out ready, willing, and able to contribute to growing the U.S. innovation economy.

- China has great student participation in STEM education with progressive and positive attitude towards STEM as it can generate more opportunities.
- Teachers play a vital role in the success of any STEM program in K-12 schools.
- Teachers are facing instructional challenges because of the interdisciplinary nature of the STEM curriculum and the current typical school structure.
- The success depends on teachers' beliefs and their knowledge in adapting to instructional implementation of STEM concepts.

Dong et al. *International Journal of STEM Education*  
<https://doi.org/10.1186/s40594-020-00245-0>

(2020) 7:47

International Journal of  
STEM Education

## RESEARCH

## Open Access

Understanding intrinsic challenges to STEM instructional practices for Chinese teachers based on their beliefs and knowledge base



Yan Dong<sup>1</sup>, Jing Wang<sup>1</sup>, Yuning Yang<sup>2\*</sup>  and Premnadh M. Kurup<sup>3</sup>





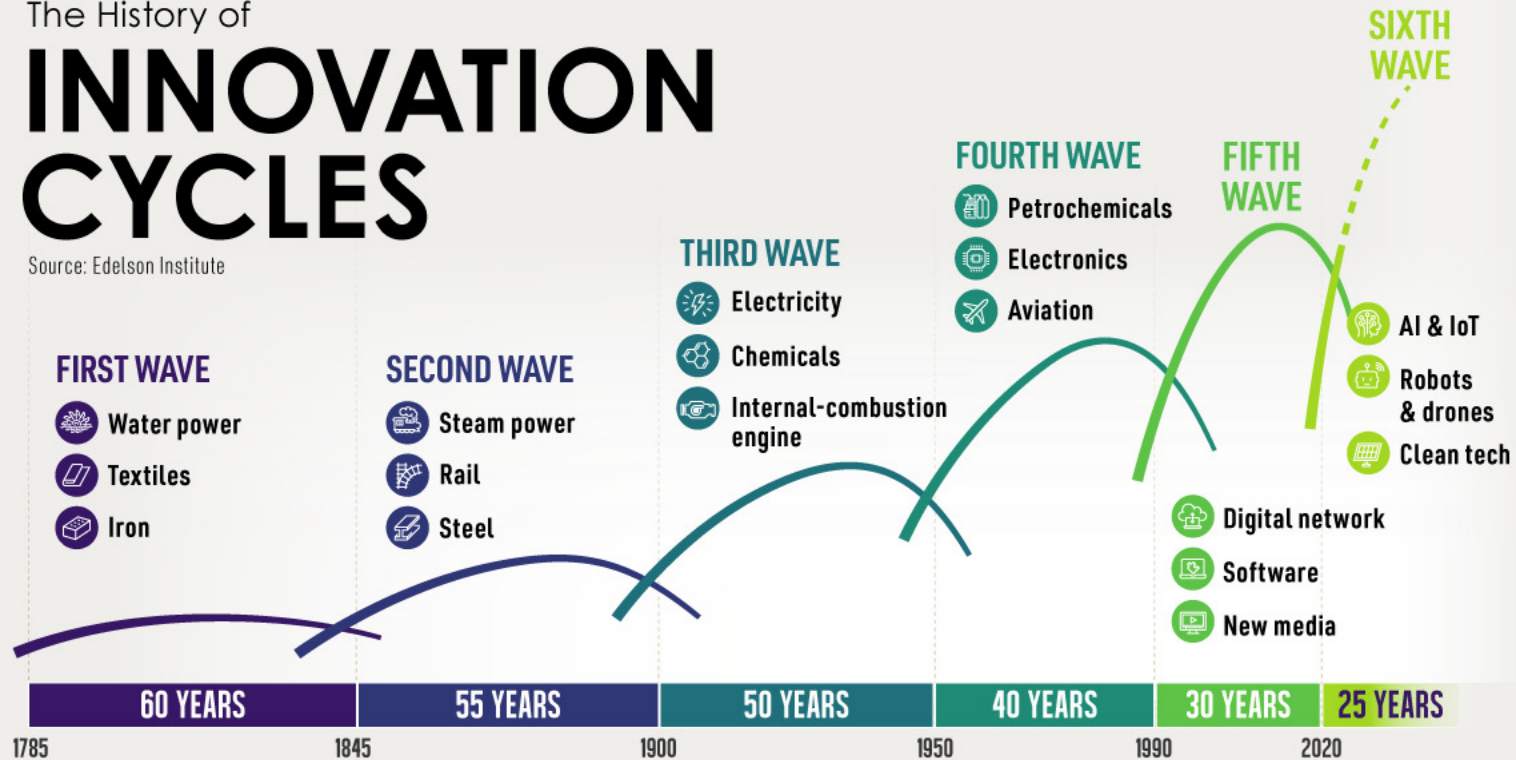
# STEM Education: A China Perspective 2

- A lack of understanding of the interdisciplinary nature of STEM-based curricula, specifically not knowing how to effectively integrate STEM-related subject areas
- A lack of understanding of content and standards in other subjects that they do not major in, especially not understanding what engineering education is
- A lack of time, including the time for collaborative planning, integrating content from different disciplines, developing STEM curriculum activities with other fellow teachers, and implementing STEM teaching and learning activities;
- The influence of school organization and structure;
- The impact of traditional exams;
- Insufficient teaching resources and materials.

The History of

# INNOVATION CYCLES

Source: Edelson Institute



- Revamp school education across the board
- All govt. and other schemes must reach the target
- Unity in diversity: Unified program with regional specifics
- Policy decisions with participation of **practicing** academicians
- Strengthen the existing systems rather than create new
- Stress STEM education: “All STEM for some”
- Industry-academia interaction and cooperation
- More quality Ph.D’s for Universities/Institutes teaching
- Implement accountability

# Welcome BP

## To our league

# THANKS