Can Technology Overcome Social Disadvantage of School Children's Learning Outcomes?

Evidence from a Large-Scale Experiment in India

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- Issues - Teacher absenteeism; Lack of adequate teacher training; Lack of physical infrastructure
- Socio-economic disadvantage along caste lines is also reflected in low education performance of children

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- Technology and change in pedagogy has to go together
- Can technology mitigate problems of discriminatory treatment in classrooms?

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- Is the impact neutral across various social and gender groups?

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- Randomized control trial design

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- At school level - schools around the median performance get maximum benefit.

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School Education in Karnataka

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- Karnataka one of the better performing states in the country
  - Per Capita income 14% higher than national average
  - Literacy rate 75.4% against national average of 73%
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- 75,000+ schools out of which 14000+ have secondary section.
- 10.1 million students in 2014-15
- However, poor performance on quality of education compared to national standards

Learning Levels of Children in Class VIII

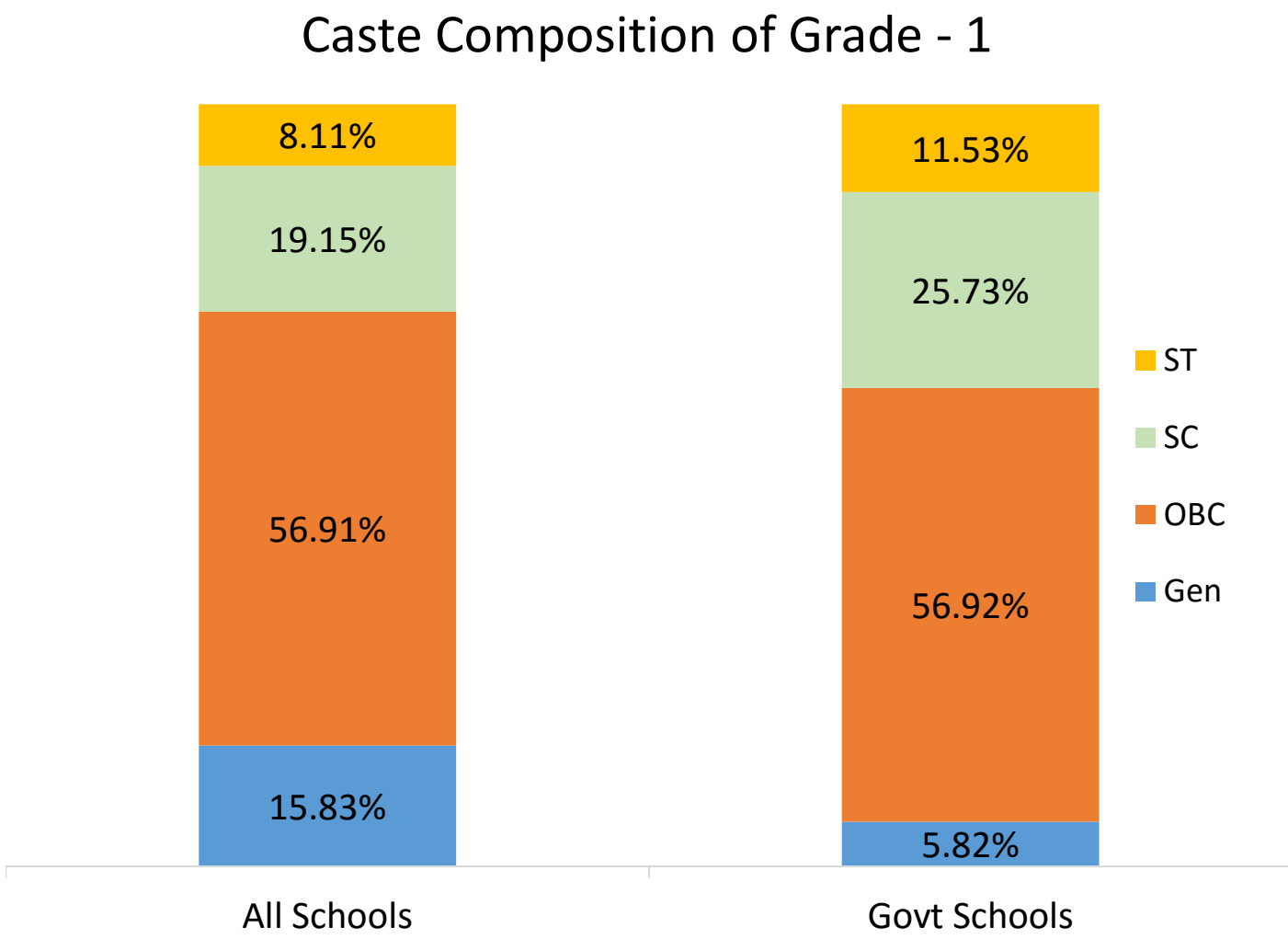
Table: Learning Levels of Children in Class VIII

	Reading Levels					
	Not even letter	Letter	Word	Std I text	Std II text	Total
India	1.8	4.5	6.2	12.8	74.6	100
Karnataka	2.7	3.7	6.5	16.6	70.6	100
	Arithmetic					
	Recognize Numbers			Can Subtract	Can Divide	Total
	None	1-9	10-99			
India	1.3	5.4	26.1	23.2	44.1	100
Karnataka	1.1	2.3	31.2	28.4	37.0	100

Source - ASER (2014)

Caste and Gender Divide in Schools in Karnataka

Enrollment in Grade - 1 in AY 2013-14



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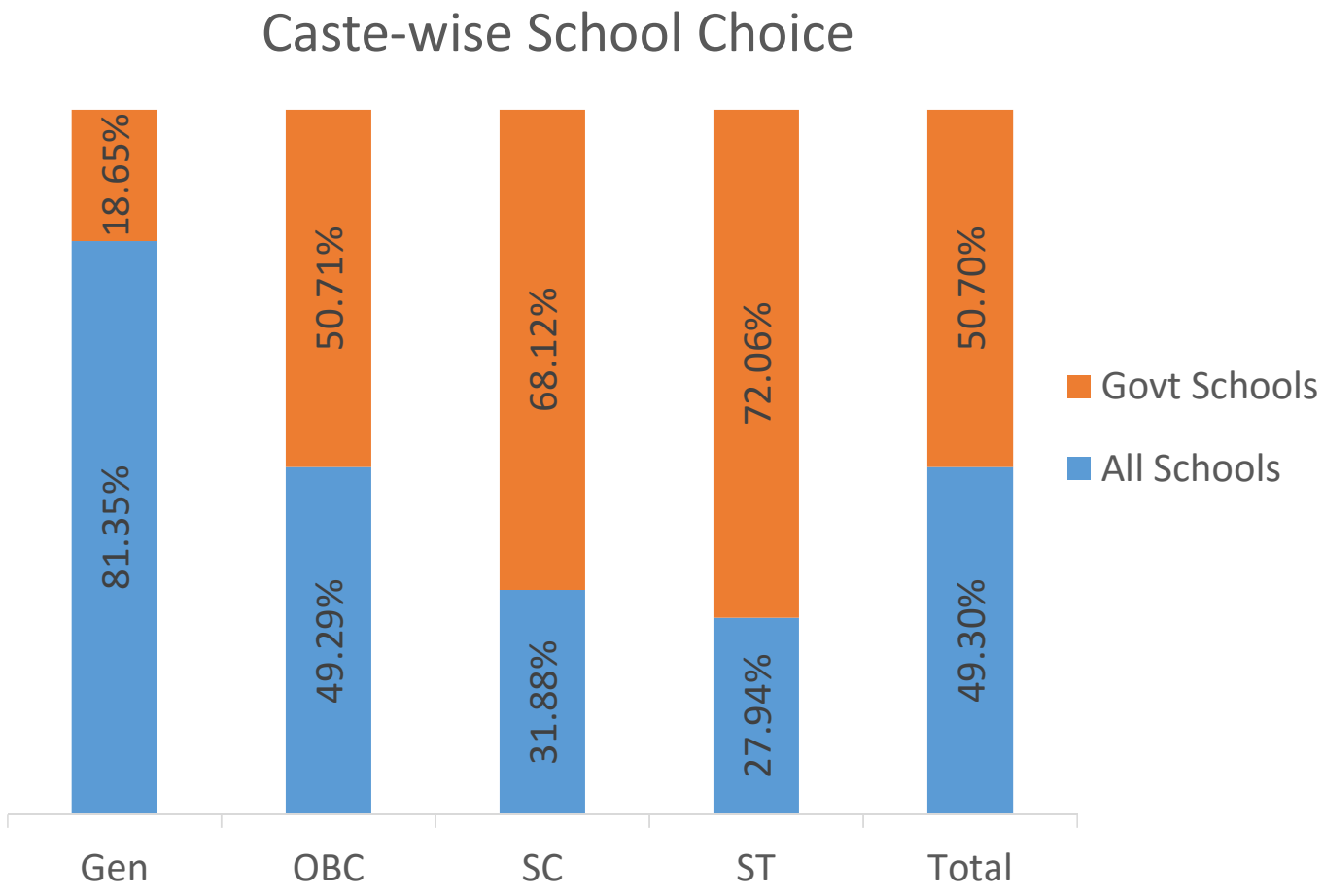

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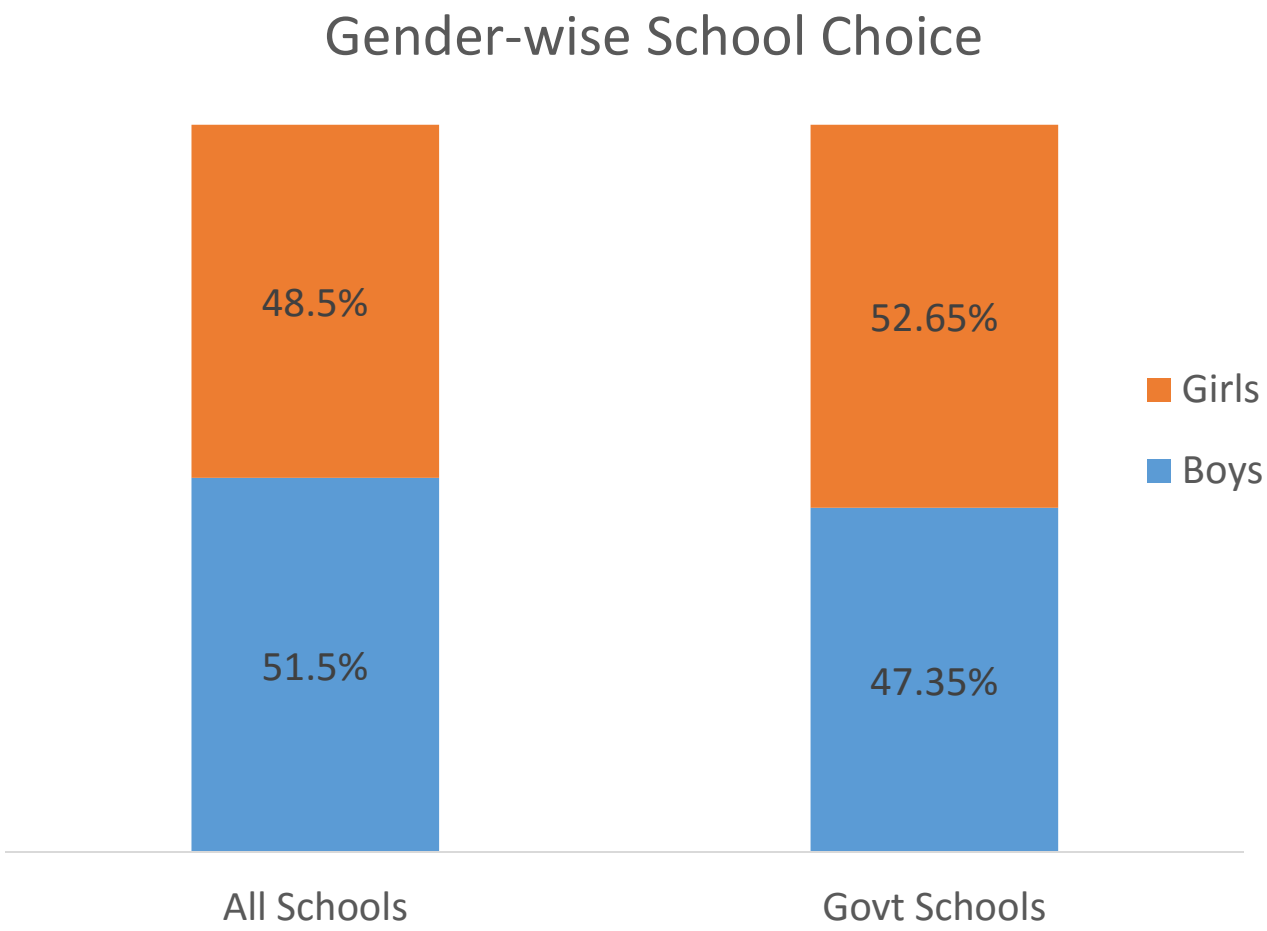

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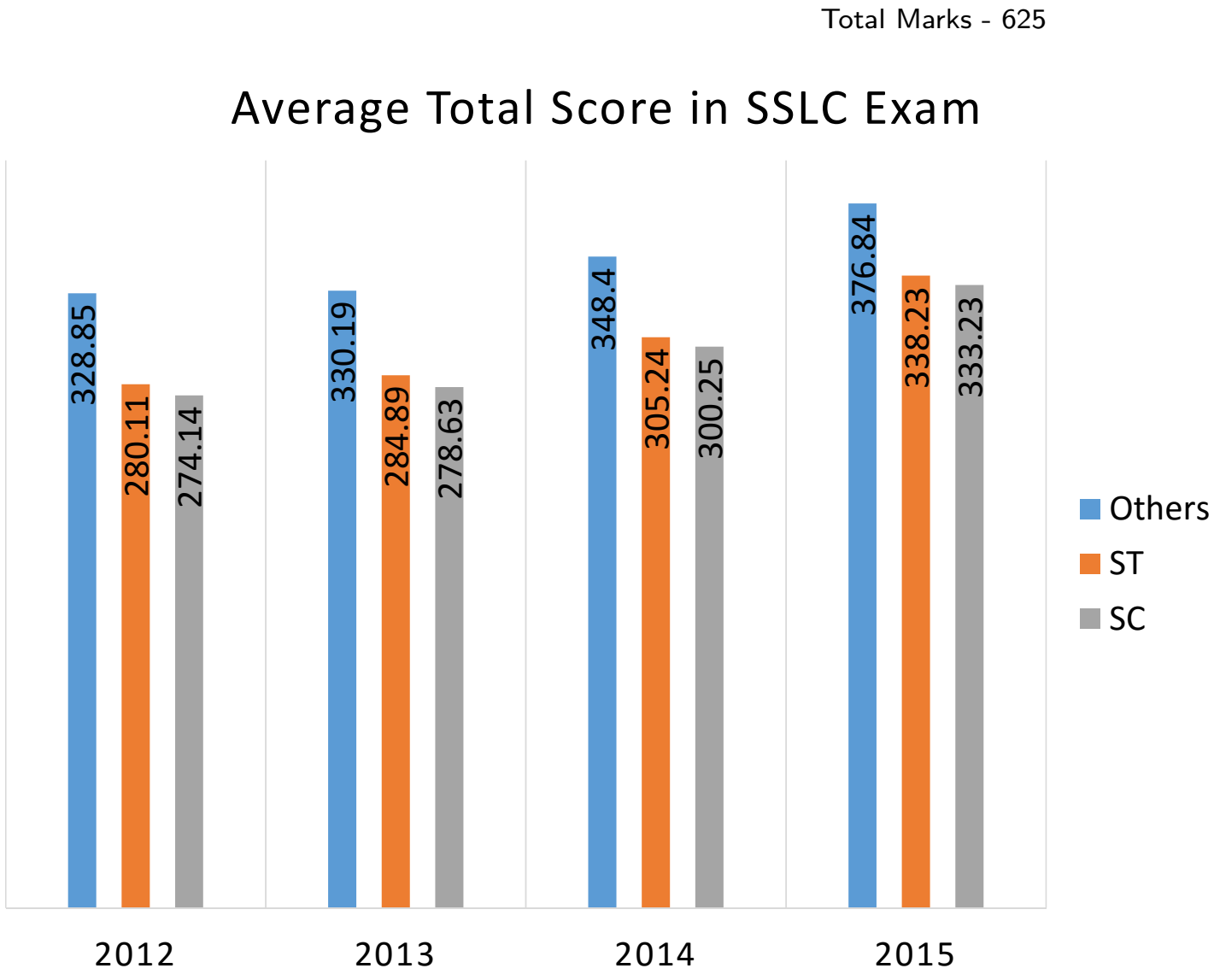

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- Lectures delivered by trained and experienced teachers using multi-media content

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Figure: Intervention Design

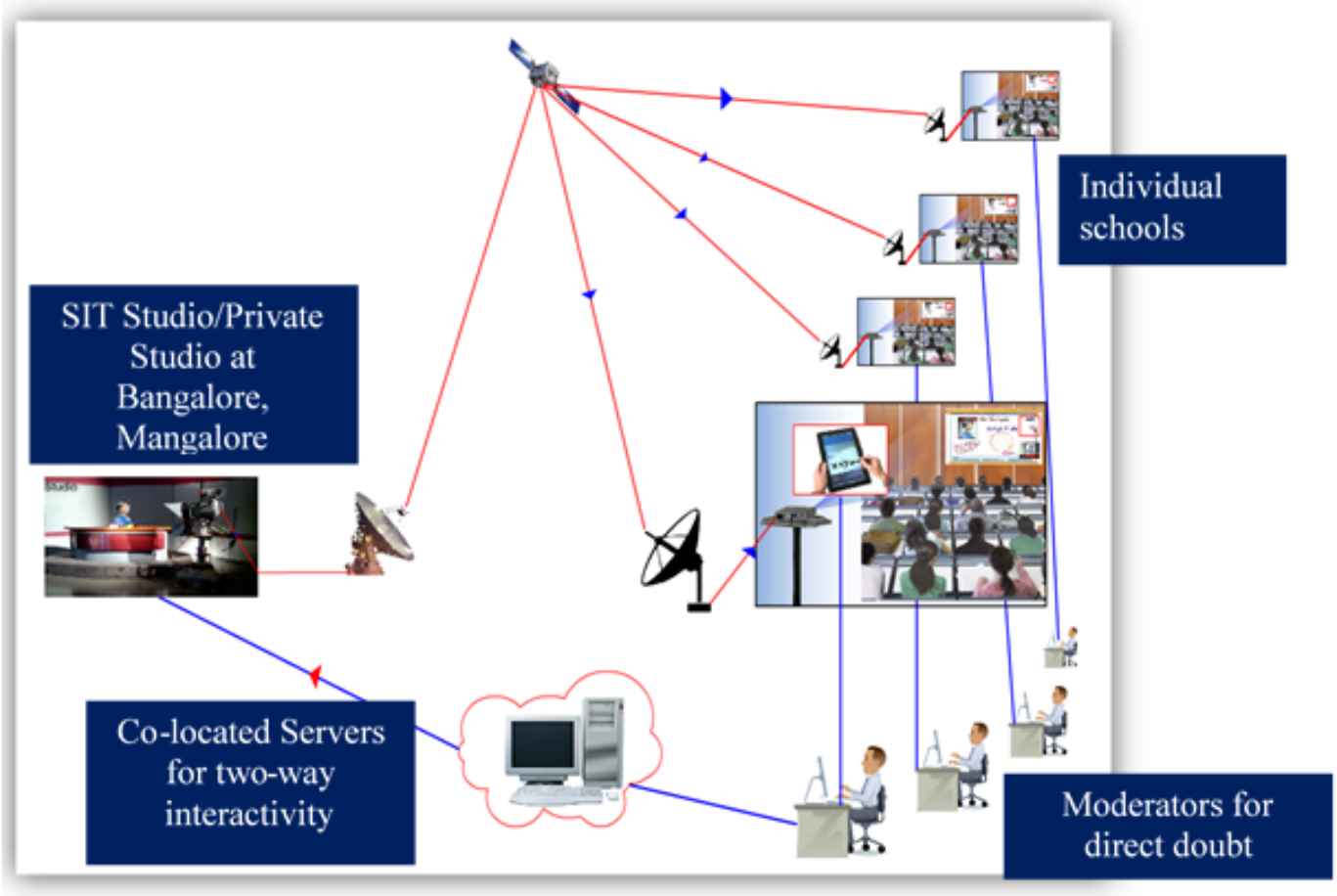

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Figure: SAMIE Class

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- Covers syllabus for grades V to X

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- 40 minutes of lecture followed by 5 minutes for interactive session

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- Minimal technical operations required at school level
- Automated + manual confirmation of class-run status
- Hence high rate of compliance

Sampling and Randomization

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- Stratification at district level and randomization at taluk level

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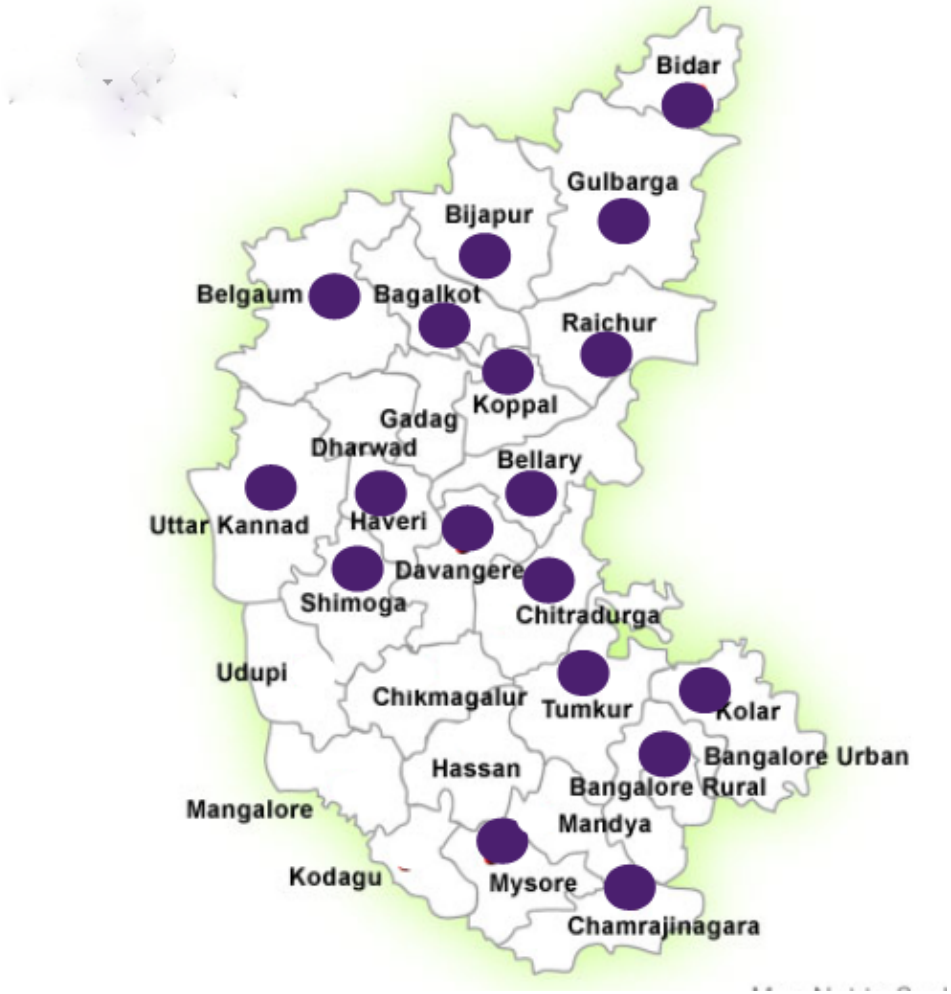
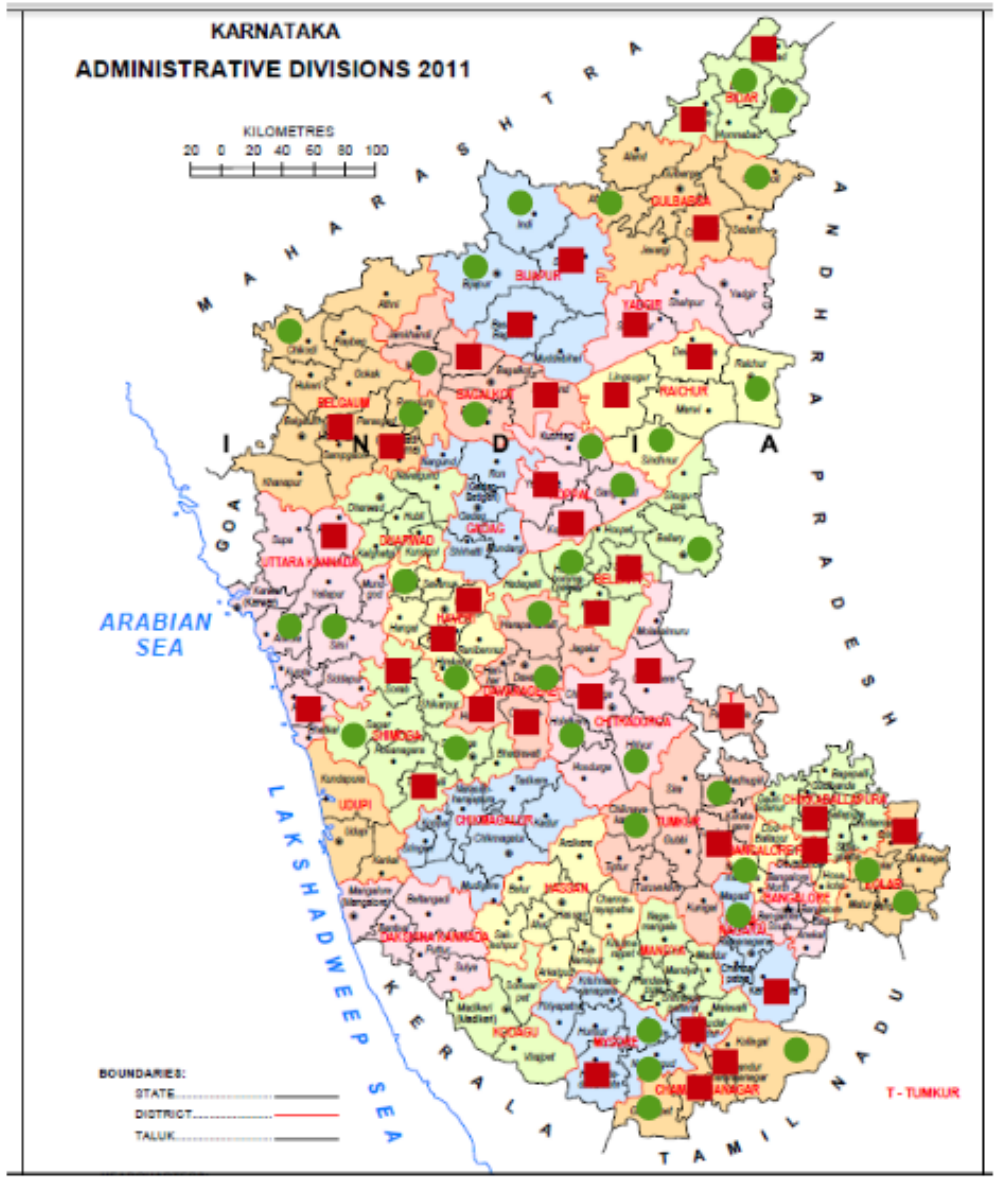
- Stratification at district level and randomization at taluk level
- Measure of outcomes at school and student level

Karnataka

Selected Districts



Intervention and Comparison Taluks



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  - Closed classroom in good condition
  - Working electricity connection
  - Minimum average of 20 students in each class

Sampling and Randomization

- Covers 72 taluks in 18 least developed districts
- Covers all government and government aided schools in selected taluk that have -
  - Closed classroom in good condition
  - Working electricity connection
  - Minimum average of 20 students in each class
- 1000 schools in intervention group; 823 schools in comparison group

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Interim Evaluation

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- Evaluation of performance of two cohorts in Grade 10 - (AY 2013-14 and AY 2014-15)

Interim Evaluation

- Intervention started in November, 2014
- Interim evaluation after 3 months of intervention in AY 2014-15
- Evaluation of performance of two cohorts in Grade 10 - (AY 2013-14 and AY 2014-15)
- Schools covered in present study - 659 from Intervention group and 587 from Control group

Schools Covered

	Intervention	Comparison
Schools in Experiment Group	1000	823
Students in Experiment Group		
Schools with Secondary Sections		
Schools in Experiment Group	659	587
Students in Experiment Group in 2014	41240	36804
Students in Experiment Group in 2015	42958	38127

Comparison of Schools with Secondary Section

Table: School Characteristics

	Control Mean	Treatment Mean	t-statistic	p-value
Total Enrolment	211.10	204.78	0.83	0.40
Total Classrooms	5.27	5.45	−1.06	0.29
Working Teachers	8.36	8.32	0.27	0.79
Pupil-Teacher-Ratio	26.30	25.16	1.24	0.22
Pupil-Classroom-Ratio	44.72	40.79	3.31	0.00
Infrastructure Score	7.24	7.32	−1.27	0.20

Comparison of Schools with Secondary Section

Table: Teachers in Secondary Section

	Control Mean	Treatment Mean	t-statistic	p-value
Number of Teachers	8.78	8.76	0.08	0.94
Number of Female Teachers	2.43	2.42	0.06	0.95
Academic Qualification Score	13.47	13.64	−1.25	0.21
Professional Qualification Score	1.89	1.91	−1.05	0.29
Proportion of Female Teachers	0.26	0.26	0.27	0.78
Proportion of OBC Teachers	0.48	0.50	−1.16	0.25
Proportion of SC Teachers	0.17	0.17	0.26	0.79
Proportion of ST Teachers	0.07	0.07	−0.80	0.43

Comparison of Schools with Secondary Section

	Control Mean	Treatment Mean	t-statistic	p-value
	Student Demographics in AY 2013-14 - Grade 10			
Proportion of Girls	0.47	0.47	−0.09	0.93
Proportion of OBC	0.44	0.47	−1.42	0.16
Proportion of SC	0.23	0.23	−0.20	0.84
Proportion of ST	0.11	0.13	−3.88	0.00
	Student Demographics in AY 2014-15- Grade 10			
Proportion of Girls	0.47	0.48	−1.29	0.20
Proportion of OBC	0.48	0.49	−0.33	0.74
Proportion of SC	0.24	0.24	−0.10	0.92
Proportion of ST	0.11	0.14	−4.02	0.00

Comparison of Schools with Secondary Section

Table: SSLC Exam Performance in April 2014

	Control Mean	Treatment Mean	t-statistic	p-value
No. of students in grade 10	62.70	62.58	0.05	0.96
No. of students who passed the exam	54.12	54.56	−0.22	0.83
English	47.39	47.65	−0.50	0.62
Maths	45.38	46.13	−1.54	0.12
Science	49.50	49.59	−0.19	0.85
Social Science	60.42	61.06	−1.05	0.29
Total Score	334.04	338.16	−1.42	0.16

1) No. of Students measures average class size in each school in grade 10

2) No. of students who passed the exam is the average no. of students from each school

3) The other variables are the average scores by students of a school in respective subjects.

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Student Level - Overall

	Dependent variable:		
	English	Maths	Science
	(1)	(2)	(3)
Treatment	−0.044	0.707	0.082
	(1.020)	(0.984)	(0.954)
Year(2015)	−7.050***	−1.790**	−5.850***
	(0.920)	(0.871)	(0.863)
Treatment:Year(2015)	0.439	−0.201	0.617
	(1.280)	(1.340)	(1.320)
Constant	48.400***	47.300***	50.000***
	(2.120)	(0.917)	(1.020)
Observations	159,129	159,129	159,129
R^2	0.062	0.025	0.062
Note:			*p<0.1; **p<0.05; ***p<0.01

All regressions include district dummies. Figures in brackets are standard errors and are clustered at taluk level

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	Dependent variable:		
	English	Maths	Science
	(1)	(2)	(3)
Treatment	−0.094	−0.024	−0.016
	(0.235)	(0.183)	(0.162)
Year(2015)	−0.717***	−0.189	−0.923***
	(0.142)	(0.121)	(0.122)
Girls	2.590***	2.210***	2.400***
	(0.343)	(0.263)	(0.254)
Treatment:Year(2015)	0.166	0.203	0.253
	(0.226)	(0.189)	(0.169)
Treatment:Girls	0.130	0.097	−0.015
	(0.470)	(0.359)	(0.333)
Year(2015):Girls	0.256	0.130	1.050***
	(0.261)	(0.242)	(0.302)
Treatment:Year(2015):Girls	−0.319	−0.495	−0.490
	(0.386)	(0.329)	(0.367)
Constant	1.410***	0.992***	1.270***
	(0.266)	(0.216)	(0.242)
Observations	159,129	159,129	159,129
R^2	0.248	0.257	0.283
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Intervention improves the gap in learning outcomes in favor of Boys

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Social Disadvantage

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- Does Intervention help in narrowing the social divide in terms of learning outcomes?
- Does Intervention improve the learning outcomes of socially disadvantaged groups?

Social Disadvantage and Learning Outcomes (I)

	Dependent variable:		
	English	Maths	Science
	(1)	(2)	(3)
Treatment	0.144	0.310	0.146
	(0.376)	(0.307)	(0.268)
OBC	-0.982^{***}	-0.613^{***}	-0.598^{***}
	(0.242)	(0.186)	(0.148)
SC	-3.340^{***}	-3.630^{***}	-3.180^{***}
	(0.381)	(0.346)	(0.261)
ST	-3.740^{***}	-3.450^{***}	-3.310^{***}
	(0.419)	(0.370)	(0.275)
Treatment:OBC	0.005	−0.243	−0.257
	(0.476)	(0.392)	(0.353)
Treatment:SC	−0.325	−0.345	−0.154
	(0.571)	(0.511)	(0.430)
Treatment:ST	−0.539	−0.542	0.088
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Social Disadvantage and Learning Outcomes (II)

	Dependent variable:		
	English	Maths	Science
	(1)	(2)	(3)
Year(2015)	−1.010***	−0.552***	−0.646***
	(0.189)	(0.125)	(0.157)
Treatment:Year(2015)	0.152	0.180	0.146
	(0.283)	(0.223)	(0.224)
Year(2015):OBC	0.435**	0.425**	0.299*
	(0.219)	(0.193)	(0.158)
Year(2015):SC	0.682**	0.646**	0.167
	(0.300)	(0.275)	(0.289)
Year(2015):ST	1.240***	1.360***	0.918**
	(0.442)	(0.329)	(0.381)
Treatment:Year(2015):OBC	−0.158	−0.239	−0.004
	(0.321)	(0.268)	(0.254)
Treatment:Year(2015):SC	−0.072	−0.052	−0.057
	(0.456)	(0.412)	(0.355)
Treatment:Year(2015):ST	−0.571	−0.821*	−0.893*
	(0.564)	(0.432)	(0.528)
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Does Intervention help in narrowing the social divide in terms of learning outcomes?

No

Social Disadvantage and Learning Outcomes (III)

	Dependent variable:		
	English	Maths	Science
	(1)	(2)	(3)
Year(2015)	−1.010***	−0.552***	−0.646***
	(0.189)	(0.125)	(0.157)
Treatment:Year(2015)	0.152	0.180	0.146
	(0.283)	(0.223)	(0.224)
Year(2015):OBC	0.435**	0.425**	0.299*
	(0.219)	(0.193)	(0.158)
Year(2015):SC	0.682**	0.646**	0.167
	(0.300)	(0.275)	(0.289)
Year(2015):ST	1.240***	1.360***	0.918**
	(0.442)	(0.329)	(0.381)
Treatment:Year(2015):OBC	−0.158	−0.239	−0.004
	(0.321)	(0.268)	(0.254)
Treatment:Year(2015):SC	−0.072	−0.052	−0.057
	(0.456)	(0.412)	(0.355)
Treatment:Year(2015):ST	−0.571	−0.821*	−0.893*
	(0.564)	(0.432)	(0.528)
Note:			*p<0.1; **p<0.05; ***p<0.01

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Does Intervention improve the learning outcomes within socially disadvantaged groups?

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Does Intervention improve the learning outcomes within socially disadvantaged groups?

	English	Maths	Science
OBC			✓
SC	✓	✓	✓
ST			

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Gender and Social Disadvantage

Gender and Social Disadvantage

- Does Intervention help in narrowing gap in learning outcomes of Girls between communities?

Gender and Social Disadvantage

- Does Intervention help in narrowing gap in learning outcomes of Girls between communities?
- Does Intervention help in improving the learning outcomes of Girls within socially disadvantaged communities?

Gender and Social Disadvantage

- Does Intervention help in narrowing gap in learning outcomes of Girls between communities?
- Does Intervention help in improving the learning outcomes of Girls within socially disadvantaged communities?
- Does Intervention help in narrowing gender gap in learning outcomes within communities?

Gender and Social Disadvantage

	Summary of impact of treatment on :								
	Girls between caste[a]			Girls within caste[b]			Gender gap within caste[c]		
Dep. var.	English	Maths	Science	English	Maths	Science	English	Maths	Science
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
OBC	−0.456	−0.037	0.328	−0.305	−0.369	−0.033	−0.492	−0.579	−0.266
	(0.634)	(0.574)	(0.576)	(0.336)	(0.307)	(0.307)	(0.456)	(0.416)	(0.418)
SC	−0.032	0.544	0.106	0.097	0.170	−0.236	0.025	0.104	−0.632
	(0.445)	(0.356)	(0.308)	(0.504)	(0.456)	(0.437)	(0.635)	(0.567)	(0.577)
ST	−1.030	−0.540	−0.542	−0.922	−0.956*	−0.956	−0.803	−0.492	−0.268
	(0.867)	(0.785)	(0.788)	(0.638)	(0.570)	(0.593)	(0.874)	(0.778)	(0.814)

Note: *p<0.1; **p<0.05; ***p<0.01

[a] Data used for these regressions include all girls.

[b] Data used for these regressions include only girls from respective caste groups.

[c] Data used for these regressions include all students from respective caste groups.

Regressions also include a full set of interaction terms with a constant. Coefficients shown here are relevant interaction terms with Year, Treatment and Caste / Gender dummies as applicable. All regressions include district dummies and controls for school characteristics. Figures in brackets are standard errors and are clustered at taluk level.

Is Technology Gender Neutral?

	Dependent variable:		
	English	Maths	Science
Prop.Female Teachers	0.318	−0.371	0.009
	(0.605)	(0.496)	(0.500)
Girls:Prop.Female Teachers	−1.130	0.468	−0.540
	(1.180)	(1.000)	(1.040)
Prop.Female Teachers:Treatment	−0.823	−0.183	−0.539
	(0.835)	(0.700)	(0.650)
Prop.Female Teachers :Year(2015)	−0.450	−0.692	−1.190*
	(0.750)	(0.557)	(0.632)
Girls:Prop.Female Teachers:Treatment	2.310	0.763	1.790
	(1.650)	(1.400)	(1.380)
Girls:Prop.Female Teachers:Year(2015)	1.460	1.940*	2.940**
	(1.410)	(1.170)	(1.420)
Prop.Female Teachers:Treatment:Year(2015)	0.619	1.190	1.000
	(1.010)	(0.810)	(0.853)
Girls:Prop.Female Teachers:Treatment:Year(2015)	−1.880	−3.030*	−2.660
	(1.990)	(1.670)	(1.910)
Observations	159,129	159,129	159,129
R^2	0.248	0.257	0.283
Note:	*p<0.1; **p<0.05; ***p<0.01		

All regressions include district dummies and controls school characteristics. Figures in brackets are standard errors and are clustered at taluk level. Regressions also include a full set of interaction terms with a constant. Only the relevant coefficients are shown here.

Is Technology Gender Neutral?

	Dependent variable:		
	English	Maths	Science
Prop.Male Teachers	−0.314	0.369	−0.006
	(0.603)	(0.494)	(0.499)
Girls:Prop.Male Teachers	1.120	−0.464	0.531
	(1.180)	(0.999)	(1.040)
Prop.Male Teachers:Treatment	0.830	0.205	0.539
	(0.830)	(0.698)	(0.648)
Prop.Male Teachers:Year(2015)	0.437	0.684	1.180*
	(0.748)	(0.555)	(0.629)
Girls:Prop.Male Teachers:Treatment	−2.330	−0.800	−1.770
	(1.640)	(1.390)	(1.380)
Girls:Prop.Male Teachers:Year(2015)	−1.440	−1.920*	−2.930**
	(1.410)	(1.170)	(1.420)
Prop.Male Teachers:Treatment:Year(2015)	−0.610	−1.190	−1.010
	(1.000)	(0.808)	(0.846)
Girls:Prop.Male Teachers:dummytT:Year(2015)	1.860	3.020*	2.630
	(1.970)	(1.660)	(1.890)
Observations	159,129	159,129	159,129
R^2	0.248	0.257	0.283
Note:	*p<0.1; **p<0.05; ***p<0.01		

All regressions include district dummies and controls school characteristics. Figures in brackets are standard errors and are clustered at taluk level. Regressions also include a full set of interaction terms with a constant. Only the relevant coefficients are shown here.

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Results - School

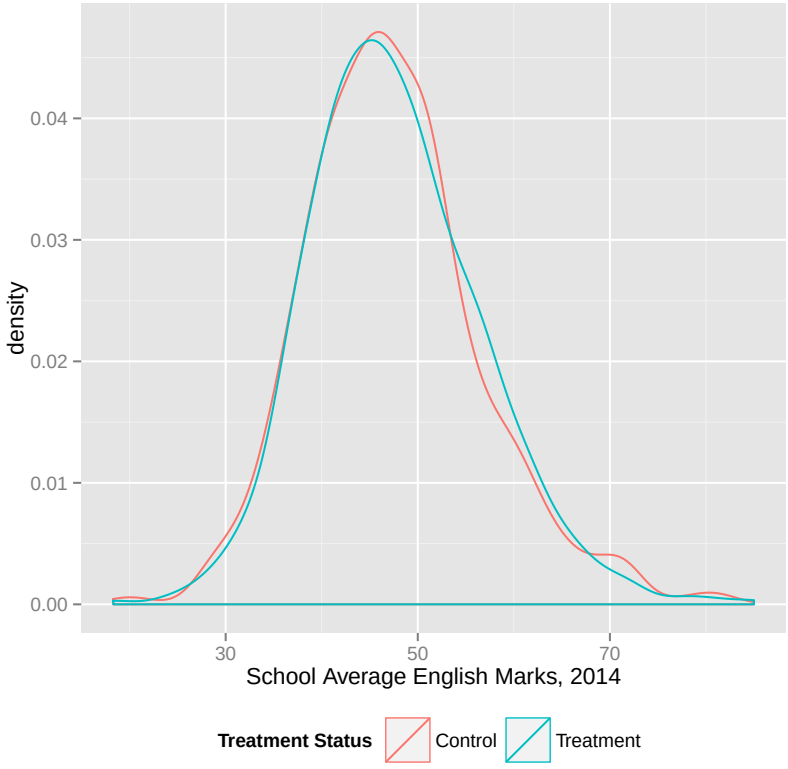
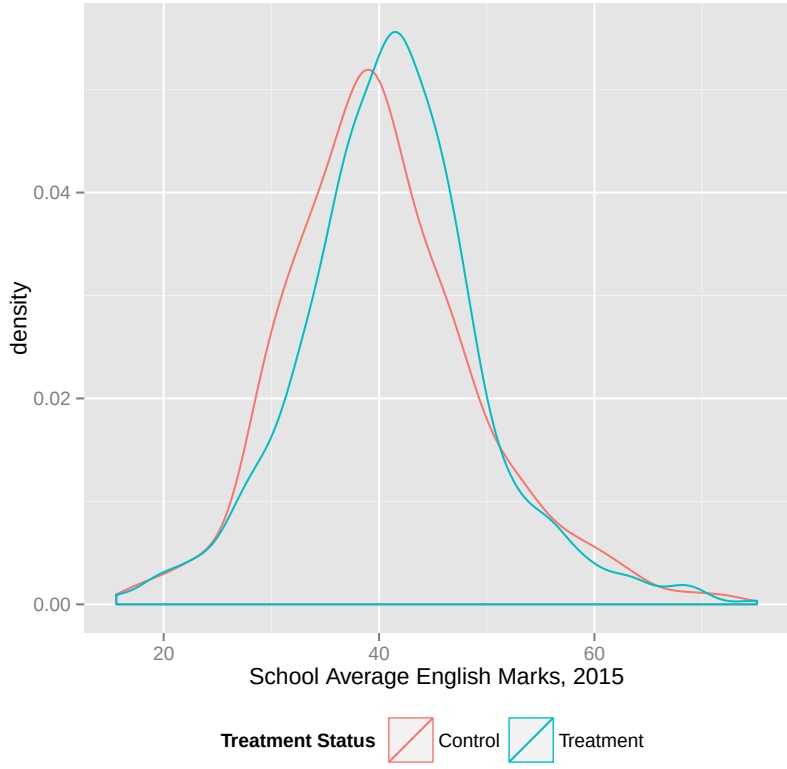


Figure: School Average English score, 2014



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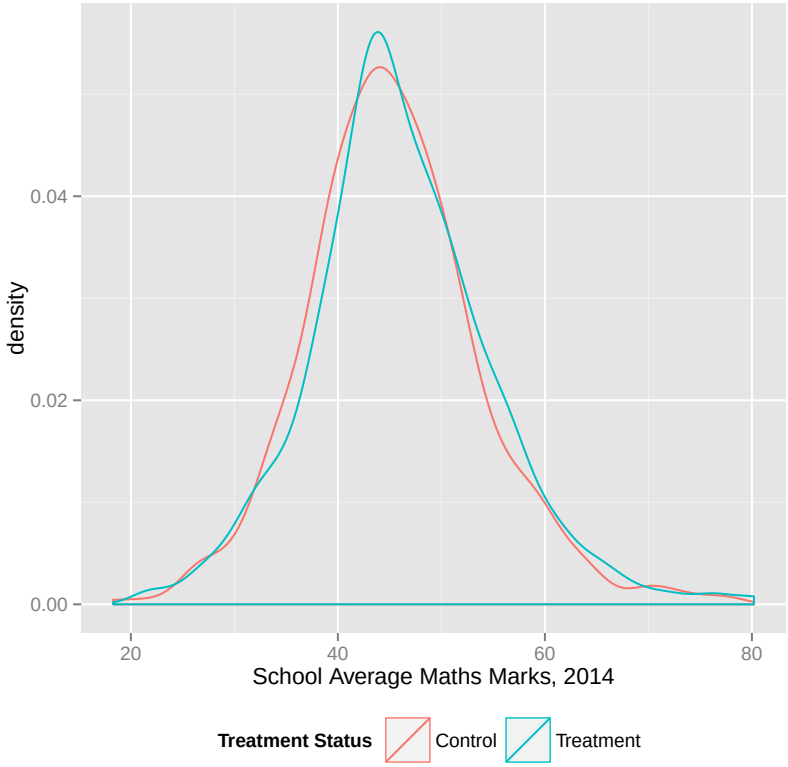

Figure: School Average Maths score, 2014

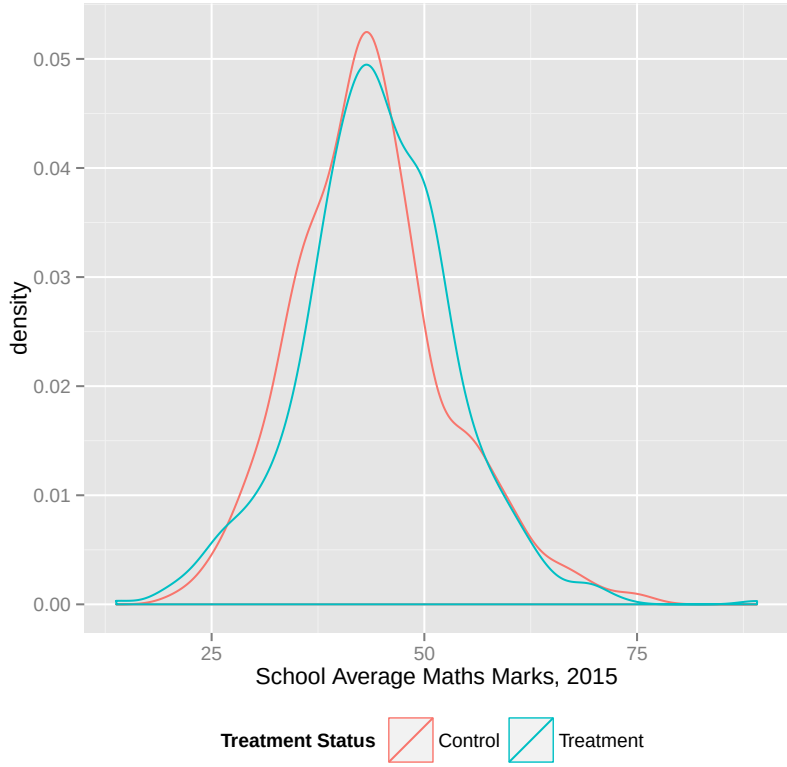

Figure: School Average Maths score, 2015

Results - School

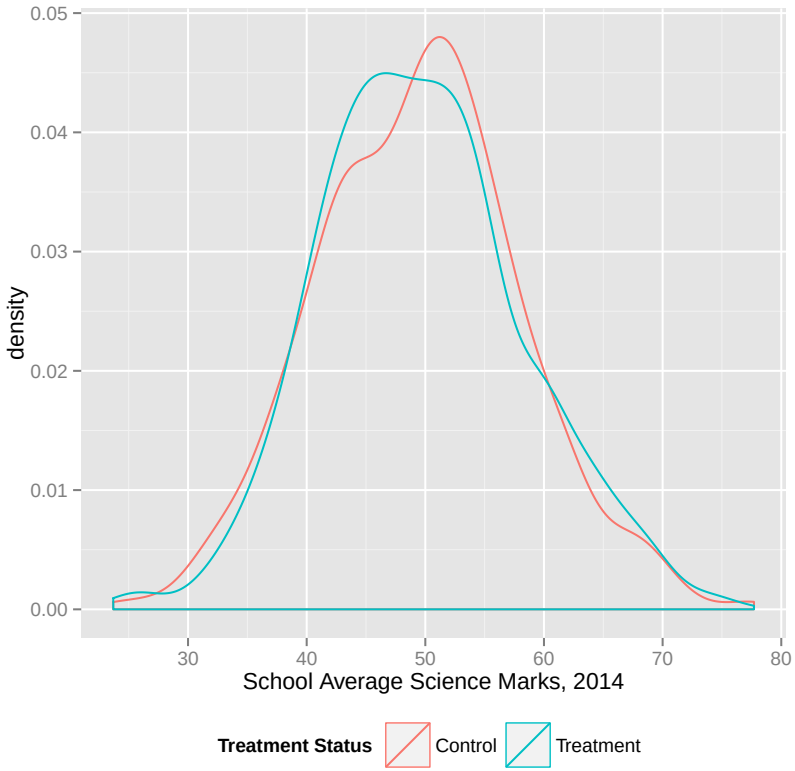

Figure: School Average Science score, 2014

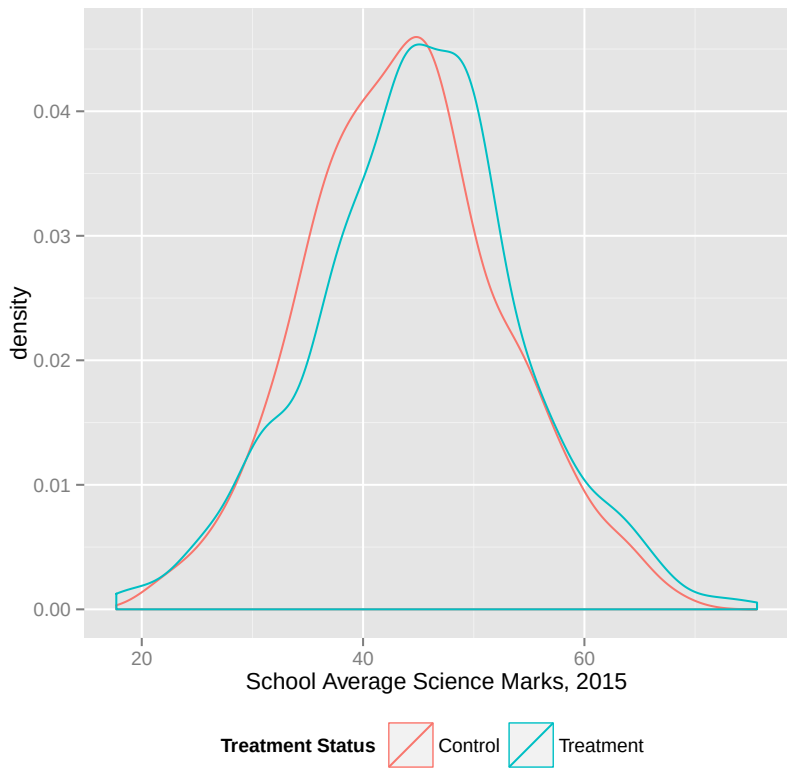

Figure: School Average Science score, 2015

School Level Average Value-add Scores

	Dependent variable:		
	English	Maths	Science
	(1)	(2)	(3)
Treatment	0.447	0.078	0.983
	(0.666)	(0.781)	(0.634)
Avg.English(2014)	-0.459^{***}		
	(0.031)		
Avg.Maths(2014)		-0.420^{***}	
		(0.043)	
Avg.Science(2014)			-0.398^{***}
			(0.032)
Constant	16.000^{***}	19.300^{***}	18.200^{***}
	(1.430)	(2.510)	(2.500)
Observations	1,246	1,246	1,246
R^2	0.408	0.335	0.364
Note:		*p<0.1; **p<0.05; ***p<0.01	

All regressions include district dummies.

Figures in brackets are standard errors and are clustered at taluk level.

Impact by Quartiles

Table: Pooled Regression - Quartiles - School Level Average Scores - District Dummies

	School Average Scores			
	Q1	Q2	Q3	Q4
English	1.184	2.109**	−0.605	0.796
	(0.911)	(0.842)	(0.962)	(1.318)
Maths	0.085	1.493	−1.200	0.335
	(1.030)	(0.920)	(0.973)	(1.329)
Science	−0.412	1.830*	1.084	2.575**
	(1.005)	(0.940)	(0.942)	(1.166)
Note:		*p<0.1; **p<0.05; ***p<0.01		

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Summarizing the Results

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- Overall - Positive but not significant (yet)

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- Overall gender gap seen narrowing in favor of boys.

Summarizing the Results

- Overall - Positive but not significant (yet)
- Overall gender gap seen narrowing in favor of boys.
- Schools around the median performance level benefit

Summarizing the Results

- Positive impact seen on some socially disadvantaged groups.

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- Positive impact seen on some socially disadvantaged groups.
- Girls within some socially disadvantaged groups are seen benefiting.

Summarizing the Results

- Positive impact seen on some socially disadvantaged groups.
- Girls within some socially disadvantaged groups are seen benefiting.
- Positive impact on gender gap within some socially disadvantaged groups.

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- Positive impact seen on some socially disadvantaged groups.
- Girls within some socially disadvantaged groups are seen benefiting.
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Conclusion and Way Forward

- Interim Results
- Project expected to generate richer data at student level
- Overall impact seems positive after 3 months of intervention
- Though more attention needed towards equity impact of technology use

Thank You ...

Pooled Regression on Quartiles by School Level Average Scores

	School Average Scores											
	English				Maths				Science			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Treatment	−0.189	−0.214	−0.885	−0.958	0.369	0.161	0.427	−0.178	0.926	−1.417**	−0.686	−1.253
	(0.683)	(0.603)	(0.697)	(0.956)	(0.773)	(0.658)	(0.704)	(0.964)	(0.754)	(0.673)	(0.682)	(0.846)
Year(2015)	−3.951***	−7.653***	−6.973***	−10.338***	1.793**	−2.662***	−1.391*	−4.596***	−2.156***	−5.869***	−6.394***	−8.814***
	(0.652)	(0.591)	(0.710)	(0.991)	(0.737)	(0.645)	(0.718)	(1.000)	(0.720)	(0.659)	(0.695)	(0.877)
Treatment:Year(2015)	1.184	2.109**	−0.605	0.796	0.085	1.493	−1.200	0.335	−0.412	1.830*	1.084	2.575**
	(0.911)	(0.842)	(0.962)	(1.318)	(1.030)	(0.920)	(0.973)	(1.329)	(1.005)	(0.940)	(0.942)	(1.166)
Constant	40.699***	45.928***	49.178***	56.854***	38.022***	46.047***	48.540***	54.448***	40.990***	48.272***	51.342***	58.436***
	(1.492)	(1.029)	(0.996)	(1.694)	(1.688)	(1.124)	(1.007)	(1.708)	(1.648)	(1.149)	(0.975)	(1.499)
Observations	624	622	624	622	624	622	624	622	624	622	624	622
R^2	0.182	0.357	0.344	0.322	0.120	0.109	0.118	0.164	0.175	0.241	0.274	0.280
Adjusted R^2	0.155	0.335	0.323	0.300	0.091	0.080	0.088	0.136	0.148	0.216	0.250	0.256
Residual Std. Error	5.685	5.250	5.985	8.146	6.428	5.734	6.051	8.215	6.275	5.861	5.857	7.208
F Statistic	6.717***	16.654***	15.832***	14.292***	4.102***	3.695***	4.015***	5.899***	6.402***	9.560***	11.394***	11.678***

Note: *p<0.1; **p<0.05; ***p<0.01