Spillover effect in the EdTech Intervention: Experimental Evidence from a Primary School in Rural China

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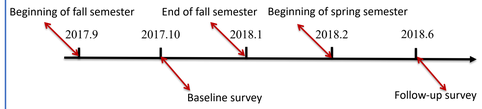
INTRODUCTION

- School performance disparities between China's urban and rural students arise as early as primary school (Zhang et al., 2015) and have been found to exist at both the national and provincial levels (Xiang et al. 2020).
- When the fraction of the work force with a relatively high degree of education is low at the national level, economic growth is hindered (Lutz, 2008), which is not beneficial to a country's long-term and stable development (Khor et al., 2016).
- EdTech interventions, which use educational technologies, including hardware, software, Internet connectivity components and content offered via these platform software, to increase learning through computerized instruction, drills, and exercises (Rouse and Krueger, 2004), have replaced traditional tutoring (Bulman and Fairlie, 2016).
- China has unique potential to the scaling of EdTech because IT infrastructure has been equipped in most Chinese classrooms (including those in rural locations) and China is also home to some of the world's largest EdTech companies.
- In addition, China has the human ability to deploy EdTech in schools, notwithstanding its difficulty in attracting high-quality instructors to rural areas (as long as adequate training is provided).
- Numerous studies have highlighted the possibilities of EdTech's potential to improve student academic achievement and bring positive societal development in rural China.
- However, less well understood is whether, and to what extent, EdTech interventions extend beyond the targeted outcome, affecting unexposed margins of behavior for untreated individuals.

METHODS

- This paper conduct a randomized controlled trial which include both the online computer assistant learning program (OCAL) and a traditional tutorial by using workbook materials (workbook) among boarding student during 2017 and 2018 academic year.
- **SAMPLE**
  - ✓ Nine nationally designated poor counties in the two prefectures
  - ✓ 86 schools and one fourth, fifth and sixth grade class in each school
  - ✓ 10, 000 students participated in the study



Four blocks in each wave:

- ➢ *Math test and scales of math learning attitude*
- ➢ *Socioeconomic status*
- ➢ *Study relationship between students*
- ➢ *Seat distribution table*

OBJECTIVES

- Whether non-boarding student exposure to an online computer assistant learning program (OCAL) which is mainly used among boarding student influences behavior outside of the targeted students.
- Whether non-boarding student exposure to a traditional tutorial materials which is also mainly used among boarding student influences behavior outside of the targeted students.
- Explores potential mechanisms underpinning the presence of spillovers.

EQUATION

$$Score_{i,endline} = \beta_0 + \gamma OCAL + \lambda workbook_i + \delta exposure_{i,baseline} + \theta boarding_{i,baseline} + +\beta_1 X_{i,baseline} + \varepsilon_i$$

$$Attitude_{i,endline} = \beta_0 + \gamma OCAL + \lambda workbook_i + \delta exposure_{i,baseline} + \theta boarding_{i,baseline} + +\beta_1 X_{i,baseline} + \varepsilon_i$$

RESULTS

Treatment Effect on Full Sample

VARIABLES	(1) Standardized math test score at follow-up survey	(2) Academic anxiety	(3) Self-concept	(4) Intrinsic motivation	(5) Instrumental motivation	(6) Studying time ratio	(7) Frequency of cooperation with classmates	(8) Distraction frequency at class	(9) Frequency of interrupting classmates	(10) Frequency to give full play to mathematics ability	(11) Frequency of getting help from teachers
OCAL group (1=yes; 0=no)	0.020	0.003	0.022	0.020	0.037	0.007	-0.087	0.041	-0.048	0.025	0.013
	(0.036)	(0.029)	(0.026)	(0.035)	(0.032)	(0.008)	(0.104)	(0.082)	(0.081)	(0.051)	(0.091)
Workbook group (1=yes; 0=no)	-0.046	-0.035	0.031	0.002	-0.043	-0.004	-0.014	0.070	0.014	0.045	0.058
	(0.038)	(0.029)	(0.025)	(0.031)	(0.031)	(0.007)	(0.094)	(0.067)	(0.081)	(0.050)	(0.094)
Exposure to boarding peers (1-yes; 0=no)	0.064***	-0.031*	0.020	0.043**	0.024	0.002	0.145***	-0.041	-0.052	0.043*	0.050
	(0.023)	(0.019)	(0.018)	(0.021)	(0.024)	(0.004)	(0.042)	(0.036)	(0.033)	(0.025)	(0.034)
Boarding (1=yes; 0=no)	-0.055***	0.018	-0.009	0.004	-0.033**	0.008*	0.016	0.071**	0.028	-0.006	0.057**
	(0.019)	(0.013)	(0.013)	(0.017)	(0.016)	(0.004)	(0.030)	(0.033)	(0.026)	(0.023)	(0.028)

Treatment Effect on Non-boarding Student

VARIABLES	(1) Standardized math test score at follow-up survey	(2) Academic anxiety	(3) Self-concept	(4) Intrinsic motivation	(5) Instrumental motivation	(6) Studying time ratio	(7) Frequency of cooperation with classmates	(8) Distraction frequency at class	(9) Frequency of interrupting classmates	(10) Frequency to give full play to mathematics ability	(11) Frequency of getting help from teachers
OCAL group (1=yes; 0=no)	0.016	-0.004	0.024	0.007	0.012	0.007	-0.104	0.045	-0.015	-0.002	-0.044
	(0.040)	(0.034)	(0.030)	(0.041)	(0.036)	(0.009)	(0.118)	(0.090)	(0.090)	(0.061)	(0.101)
Workbook group (1=yes; 0=no)	-0.052	-0.064*	0.030	0.007	-0.051	-0.005	-0.006	0.077	0.013	0.033	0.038
	(0.037)	(0.034)	(0.029)	(0.032)	(0.033)	(0.008)	(0.105)	(0.072)	(0.088)	(0.057)	(0.104)
Exposure to boarding peers (1-yes; 0=no)	0.061***	-0.029	0.020	0.047*	0.030	-0.001	0.142***	-0.032	-0.055	0.060**	0.027
	(0.023)	(0.020)	(0.021)	(0.024)	(0.027)	(0.005)	(0.045)	(0.037)	(0.038)	(0.029)	(0.035)

RESULTS

Treatment Effect on Non-boarding Student across Different Subgroups

Non-Boarding student didn't exposure to boarding peers

VARIABLES	(1) Standardized math test score at follow-up survey	(2) Academic anxiety	(3) Self-concept	(4) Intrinsic motivation	(5) Instrumental motivation	(6) Studying time ratio	(7) Frequency of cooperation with classmates	(8) Distraction frequency at class	(9) Frequency of interrupting classmates	(10) Frequency to give full play to mathematics ability	(11) Frequency of getting help from teachers
OCAL group (1=yes; 0=no)	0.053	0.006	0.051	-0.025	0.029	0.014	0.065	0.054	-0.024	0.090	-0.054
	(0.055)	(0.050)	(0.052)	(0.061)	(0.060)	(0.014)	(0.139)	(0.118)	(0.118)	(0.064)	(0.112)
Workbook group (1=yes; 0=no)	0.029	-0.123**	0.059	-0.000	-0.029	0.002	0.159	-0.052	-0.032	0.216***	0.095
	(0.046)	(0.054)	(0.045)	(0.046)	(0.048)	(0.011)	(0.116)	(0.092)	(0.117)	(0.068)	(0.125)
Observations	2,404	2,375	2,369	2,379	2,388	2,401	2,405	2,418	2,418	2,419	2,395
R-squared	0.427	0.227	0.288	0.227	0.125	0.102	0.129	0.251	0.185	0.187	0.156

Non-Boarding student exposured to boarding peers

VARIABLES	(12) Standardized math test score at follow-up survey	(13) Academic anxiety	(14) Self-concept	(15) Intrinsic motivation	(16) Instrumental motivation	(17) Studying time ratio	(18) Frequency of cooperation with classmates	(19) Distraction frequency at class	(20) Frequency of interrupting classmates	(21) Frequency to give full play to mathematics ability	(22) Frequency of getting help from teachers
OCAL group (1=yes; 0=no)	0.001	-0.009	0.013	0.029	-0.001	0.003	-0.210*	0.045	-0.003	-0.065	-0.046
	(0.041)	(0.035)	(0.030)	(0.044)	(0.038)	(0.009)	(0.117)	(0.091)	(0.089)	(0.060)	(0.109)
Workbook group (1=yes; 0=no)	-0.099**	-0.032	0.016	0.009	-0.068**	-0.009	-0.111	0.161**	0.047	-0.087	0.002
	(0.045)	(0.031)	(0.030)	(0.039)	(0.034)	(0.008)	(0.113)	(0.078)	(0.087)	(0.062)	(0.108)

Treatment Effect on Boarding Student

VARIABLES	(1) Standardized math test score at follow-up survey	(2) Academic anxiety	(3) Self-concept	(4) Intrinsic motivation	(5) Instrumental motivation	(6) Studying time ratio	(7) Frequency of cooperation with classmates	(8) Distraction frequency at class	(9) Frequency of interrupting classmates	(10) Frequency to give full play to mathematics ability	(11) Frequency of getting help from teachers
OCAL group (1=yes; 0=no)	0.028	0.011	0.021	0.046	0.083*	0.009	-0.054	0.034	-0.102	0.078	0.100
	(0.047)	(0.036)	(0.036)	(0.041)	(0.044)	(0.011)	(0.105)	(0.089)	(0.089)	(0.052)	(0.094)
Workbook group (1=yes; 0=no)	-0.035	0.012	0.029	-0.012	-0.036	-0.002	-0.034	0.070	0.020	0.068	0.093
	(0.049)	(0.035)	(0.033)	(0.043)	(0.042)	(0.010)	(0.100)	(0.081)	(0.087)	(0.052)	(0.100)
Exposure to boarding peers (1-yes; 0=no)	0.082	-0.065	0.041	0.036	0.009	0.015*	0.149*	-0.111	-0.048	-0.005	0.166**
	(0.052)	(0.043)	(0.042)	(0.043)	(0.039)	(0.009)	(0.078)	(0.071)	(0.063)	(0.053)	(0.065)

Treatment Effect on Boarding Student across Different Subgroups

Boarding student didn't exposure to boarding peers

VARIABLES	(1) Standardized math test score at follow-up survey	(2) Academic anxiety	(3) Self-concept	(4) Intrinsic motivation	(5) Instrumental motivation	(6) Studying time ratio	(7) Frequency of cooperation with classmates	(8) Distraction frequency at class	(9) Frequency of interrupting classmates	(10) Frequency to give full play to mathematics ability	(11) Frequency of getting help from teachers
OCAL group (1=yes; 0=no)	0.046	-0.055	0.053	-0.010	-0.072	-0.032	0.283**	0.168	0.113	0.238**	-0.209
	(0.101)	(0.094)	(0.088)	(0.101)	(0.112)	(0.021)	(0.140)	(0.153)	(0.158)	(0.110)	(0.161)
Workbook group (1=yes; 0=no)	0.043	-0.046	-0.111	-0.097	-0.124	-0.033	0.097	-0.052	0.101	0.108	0.136
	(0.125)	(0.088)	(0.101)	(0.105)	(0.099)	(0.024)	(0.192)	(0.163)	(0.158)	(0.136)	(0.200)
Observations	320	317	315	317	320	320	324	325	325	325	323
R-squared	0.443	0.299	0.271	0.180	0.156	0.178	0.175	0.269	0.260	0.225	0.223

Boarding student exposured to boarding peers

VARIABLES	(12) Standardized math test score at follow-up survey	(13) Academic anxiety	(14) Self-concept	(15) Intrinsic motivation	(16) Instrumental motivation	(17) Studying time ratio	(18) Frequency of cooperation with classmates	(19) Distraction frequency at class	(20) Frequency of interrupting classmates	(21) Frequency to give full play to mathematics ability	(22) Frequency of getting help from teachers
OCAL group (1=yes; 0=no)	0.022	0.016	0.018	0.050	0.094**	0.012	-0.090	0.019	-0.121	0.062	0.124
	(0.048)	(0.037)	(0.038)	(0.044)	(0.045)	(0.012)	(0.108)	(0.090)	(0.092)	(0.054)	(0.095)
Workbook group (1=yes; 0=no)	-0.042	0.016	0.038	-0.003	-0.030	0.000	-0.054	0.088	0.010	0.062	0.091
	(0.048)	(0.037)	(0.035)	(0.045)	(0.044)	(0.011)	(0.102)	(0.085)	(0.090)	(0.054)	(0.102)

CONCLUSIONS

- OCAL and workbook interventions in general do not have a significant and positive impact on students.
- However, non-boarding students' academic achievement and motivate to study are positively and significantly affected by exposure to boarding peers.
- When exposed to boarding peers, non-boarding students are also inspired to collaborate with classmates and perform to the best of their ability in math.
- However, neither intervention has positive spillover effects on non-boarding students' mathematics scores or attitudes toward learning if they are exposed to peers who have received treatment.
- In addition, if non-boarding students don't have boarding friends, workbooks have an even greater positive spillover effect on lowering their academic anxiety.
- But if treated students board with their classmates at school, their motivation to study is increased.
- Therefore, traditional tutorials have positive spillover effects, but these effects are not shared with close peers due to peer pressure. Instead, students are inspired by peers who participate in traditional tutorials but are not as close to them.
- However, when students use EdTech or workbook together, the intervention effect can be enhanced.
- On the basis of the findings of this study, we propose that schools or policymakers may employ social networks in the classroom to broaden interventions at the class level and so promote the accumulation of human capital.

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