## Learning to Teach by Learning to Learn

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## THE LEARNING CRISIS

QUALITY OF TEACHING IS A KEY BARRIER

- Teaching quality is crucial to improving student learning.
- But often, pedagogy based in rote learning of facts.
- Unfortunately, available evidence suggests general-skills teacher training does not improve desired outcomes (World Bank, 2020)
  - Structured pedagogy improves learning outcomes.
  - Nevertheless, teacher "degrees of freedom" may matter when teaching "21<sup>st</sup> century" skills like critical thinking/inquiry, scientific thinking, etc.
- We need to find effective approaches of improving teacher quality.

## This Paper

Increasing the Quality of Teaching Research Question

- Does a Novel Approach to Teacher Training Improve Teaching Quality?
  - Yes Learn to Teach by Learning to Learn

#### Approach

- Partner org. trains in-service teachers to be producers of knowledge
  - Posing sharp questions, using precise language to describe, framing specific hypotheses, using evidence and data from everyday life
- RCT of the teacher training program in Uganda
  - Trained 40% of teachers in treated schools after 2 years
  - Focus on Upper Primary (UP).



### DRAMATIC RESULTS

STAKING A CLAIM FOR GENERAL SKILLS IN-SERVICE TEACHER TRAINING



Source: Data purchased from the Uganda National Examination Bureau and Matched with Treatment Status of Schools.

## THE INTERVENTION

CURRICULUM — PREPARATION FOR SOCIAL ACTION

- Curriculum in development since mid-1970's by FUNDAEC (Colombia).
  - A tutorial program in rural secondary education that applied scientific capabilities to investigation of community processes.
    - Scaled in Colombia from 1980 2000s
    - Scaled internationally from 2000s on (Uganda in 2007)
- 2015: Kimanya Ngeyo re-invention
  - Used curriculum to design a teacher training.



# 1) Learning to Learn

Example: Conceptual Learning — Shape

 Teachers are asked to make shapes out of clay. Then, they try to describe these objects for 30 minutes.



- Teacher: "This is a cube"
- Tutor: "Really? I see some dents in that shape. How would you explain it more precisely?
- Eventually recognize that prior knowledge determines our ability to describe new objects.
  - Simple shapes are used to describe new and increasingly complex shapes.

# 2) Learning to Teach

Example: Conceptual Learning — Shape

- Metacognitive Analysis: How did experience affect thinking?
  - What elements of pedagogy are connected to thinking?
- The approach develops 1) power of expression and 2) deep understanding of the concept of shape
- Some conditions of the teacher:
  - Teacher does not assume an answer, but asks questions
  - Has an orientation of humility
  - Is open to data and refinement of ideas, etc.
- Similar exercises develop and analyze pedagogy around:
  - scientific thinking, exploratory learning, critical thinking, problem-posing, information assimilation, etc.

#### Predictions

#### Pre-specified Analysis

		<ul> <li>Baseline pedagogy — "Banking" (Freire, 1970)</li> </ul>
Upstream		<ul> <li>Teacher changes pedagogy</li> <li>Classroom Predictions: Students more engaged, Ask more questions, Spend time on concepts relevant to home life</li> <li>Teacher Predicions: Teachers more sympathetic and learn about students and learn from colleagues.</li> </ul>
		<ul> <li>Student learning improves along multiple dimensions</li> </ul>
Downstream		<ul> <li>Improvements in: standardized tests, scientific competencies, critical thinking, creativity</li> </ul>
Downstream	$\mathbf{\nabla}$	• Community: parent attitudes, practical knowledge at home, etc.

#### BALANCE TEST AND MEASUREMENT INSTRUMENTS

Statistics	Summary Statistics			Balance Tests		
	Control		Treated			
	Mean	Sd	Mean	Sd	β	p value
School Characteristics						
Gov vs. Private	0.43	0.51	0.53	0.52	0.15	0.67
N Teachers	11.79	2.42	14.53	4.84	0.02	0.83
Percent P6 and P7 Teachers	0.45	0.07	0.41	0.08	-0.45	0.79
Percent Teachers Have Diploma	0.27	0.24	0.20	0.21	-0.10	0.91
Percent Any In-Service Training < 2017	0.22	0.18	0.20	0.19	-0.17	0.78
Enrolment	487.64	268.35	550.73	314.01	0.00	0.73
Pupil-Teacher Ratio	40.12	17.21	36.41	12.43	-0.01	0.71
Joint Balance Test (OLS Specification)			F Score	e ( <i>p</i> value) Clusters	1.74 ( 29	0.14)

 Other instruments include: Teacher survey, classroom observation, PLE results, Student Survey, Student Assessment, and Science Shows

#### PLE Results



Notes: Data purchased from UNEB and standardized using control-school distribution. Robust to Multiple Hypothesis Testing.

## P6 Term 2 Science Exam

#### Example Questions

	Second SEC		KSandonius	Which class of i
	Questions 1	to 40 carry one	mark each.	
I. Give one r	eason why people ke	ep poultry.	gange en se	erro ena evic
2. State the o	component of soil form	ned by decompos	ition.	tastie eno plost
3. Name any	one invertebrate with	eight legs and th	vo main body pa	arts. en nober de
4. Mention o	ne way of keeping a la	atrine clean.	E Provinsi Statistica	all and explanation
5 Which par	t of a plant holds it firr	nly in the soil?	1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	<u></u>

#### THE SIPRO PRIMARY SIX MID - TERM II INTEGRATED SCIENCE MARKING GUIDE 2019.

NO	LEVEL	CORRECT ANSWER	WRONG ANSWER	MARKING POINT	TECHNICAL ADVICE
1	P.6	Source of eggs/ meat/ for sale	To get feathers/ Droppings	Any purpose of keeping poultry.	Guide them through the topic of keeping poultry and its details.
2	P.3	Humus	Top soil	The answer should be a component of soil not soil layer.	Differentiate between components and soil layers.
3	P.5	Tick/ Scorpion/ Spider/ mite	Housefly/ Mosquito	The answer should be an arachnid.	Guide them through different groups of arthropods
4	P.1	Scrubbing it/ Sweeping it/ Smearing it with cow dung/ Removing cob	Cleaning it	The response should be a method of cleaning a latrine.	Take them through the different ways of cleaning a latrine.
5	P.4	Roots	Stem	The response should be part of a plant found in the soil.	Guide them through the different parts of plants and their uses.
6	P.6	Both reptiles and amphibians lay eggs/ are oviparous.	Both are warm blooded	The response should be specific to mode of reproduction.	Take them through classification of animals.
			the second se		I may also show the standard tends.

Source: SIPRO Mid-Term II Science Exam (2019).

## Measurement

JUDGE'S RUBRIK: ONE-TO-ONE MAP WITH MINISTRY STATED COMPETENCIES

#### • 12 Measures Across Five Categories:

- 1 Framing the problem,
- 2 Designing the Experiment,
- 3 Articulating and Testing a Hypothesis
- 4 Measuring Outcomes
- 5 Articulating Independently.
- Example (Category 3): "The students had a clearly articulated hypothesis."
  - 1 I had no idea what hypothesis the students were testing.
  - 5 The students mentioned a hypothesis, but it was not clear.
  - 10 The students mentioned a very clear hypothesis.



### Science Show Result

#### Competency Categories



Notes: Science outcomes from judge rubrik measures.

## TEACHERS ARE MORE INQUISITIVE

INQUISITIVENESS INTERACTS WITH SCIENCE SHOW OUTCOMES IN TREATED SCHOOLS



Notes: Teacher inquisitiveness (x-axis) from teacher survey. Science outcomes from judge rubrik measures.

## Other Learning Outcomes

#### Results



Notes: Source is researcher-administered assessment to P6 students and psychometric activity to measure creativity. Categorized test questions using description in Burdett (RISE, 2017). Creativity index from Bradler, Neckermann & Warnke (2020)

## TEACHER OUTCOMES: PEDAGOGY

#### STUDENT ENGAGEMENT IN CLASS

Hypothesis:	Pedagogy	
Outcome Variable:	Share of Engaged Pupils	
Treatment (ITT)	0.39*** (0.15)	
H <sub>0</sub> : <i>ITT</i> = 0	()	
p value	[0.01] <sup>±±</sup>	
RI p value	[0.01] <sup>±±</sup>	
BH Critical p value (5%)	[0.02]	
Pair FE	Yes	
Enum FE	Yes	
Grade FE	Yes	
Source of Data	Classroom Observations	
Unit of Observation	Classroom Snapshots	
Range of Outcome Variable	{1,2,,6}	
Control School Mean	4.41	
Clusters	29	
Observations	2,380	
Estimator	Ologit	





Notes: Classroom observations using the Stallings tool utilized to measure student engagement in class.

## TEACHER OUTCOMES: PEDAGOGY

#### STUDENT QUESTIONS AND CORPORAL PUNISHMENT

Hypothesis:	Pedagogy			
Outcome Variable:	Student Inquisitiveness	Corporal Punishment		
Treatment (ITT)	0.06**	-0.01		
	(0.03)	(0.04)		
$H_0: ITT = 0$				
p value	[0.02] <sup>±±</sup>	[0.81]		
RI p value	[0.28]	[0.94]		
BH Critical p value (5%)	[0.03]	[0.05]		
Pair FE	Yes	Yes		
Enum FE	Yes	Yes		
Source of Data	Student Survey	Student Survey		
Unit of Observation	P6 Teachers	P6 Teachers		
Range of Outcome Variable	[0,1]	[0,1]		
Control School Mean	0.22	0.53		
Clusters	29	29		
Observations	95	95		
Estimator	Tobit	Tobit		



Corporal Punishment

Notes: Students are asked questions about their proclivity to ask questions in each of their teachers' classes and evidence of teachers' use of "caning." Measure aggregated at teacher-level.

## **TEACHER OUTCOMES: BEHAVIOR/EFFORT**

#### TEACHER AS RESEARCHER

	Teacher as Researcher		
Outcome Variable:	Knowledge of Student	Teacher Network	
Treatment (ITT)	0.10***	0.27**	
	(0.03)	(0.11)	
$H_0: ITT = 0$			
p value	[0.00] <sup>±±</sup>	$[0.02]^{\pm\pm}$	
RI p value	[0.06] <sup>±</sup>	[0.14]	
BH Critical p value (5%)	[0.05]	[0.05]	
Pair FE	Yes	Yes	
Enum FE	Yes	No	
Grade FE	No	No	
Source of Data	Stud. + Teach. Survey	Teacher Network	
Unit of Observation	P6 Teachers	Teacher Dyads	
Range of Outcome Variable	[0,1]	{0,1,2,3}	
Control School Mean	0.62	1.80	
Clusters	29	29	
Observations	95	1,466	
Estimator	Tobit	OLS	



Treated

2

Notes: First variable combines Teacher and Student survey to construct index of "correct" teacher responses regarding students' lives. Second variable taken from teacher survey, where a network module with 3 guestions is cross-validated within teacher-pair.

Control Teacher Within-School Learning Network

### Additional Results

• Little reason to think motivation dominates increased capacity for teaching

- Science show placebo and math score result
- No evidence of change in subjective teacher motivation
- Significant results after 2nd year of program, not 1st (effect increasing across time as capacity grows).
- Active learning pedagogy more time spent on school garden plots.
- Teachers are more sympathetic and less adversarial
  - Students less hungry in school.
- Teachers are more inquisitive.

#### CONCLUSION

- A new class of teacher trainings provides teachers with general skills with striking results on pedagogy and student learning.
  - Different from structured pedagogy, which provides teachers with scripts and targets very specific outcomes.
     (Piper et al., 2014; Banerjee et al., 2017; Muralidharan et al., 2019; Bando et al., 2019)
- A key ingredient: spend the time necessary to immerse teachers in
  - 1 New modalities of learning as learners
  - 2 Deep analysis of principles and analysis of pedagogy that creates new modalities of learning
    - → Together, equip teacher to consciously apply pedagogy to suit student learning needs.
- Invites many new lines of inquiry:
  - Community spillovers: practical knowledge, attitudes, etc.?
  - Core model transferred to other sectors (e.g., ag. extension)?
- Taking to scale: partnerships with gov and non-gov entities

### **COST-EFFECTIVENESS**

LAYS — Learning Adjusted Years of Schooling (Angrist et. al, 2020)



#### **Effectiveness**

Relative to Traditional Learning in Other Education Interventions



54 obs. RCT only. Effect Sizes pulled over subjects / measures by taking maximum. Intersection point is based on effect size closest to 0.61.

Source: Treatment effects from meta-analysis in Snilstveit et. al (2015).