Strategies for Training Teachers to Integrate Technology in the classroom

A systematic review

Sujata N Gamage, gamage@gmail.com (with Amrita Khakurel , Achala Abeykoon, Chivoin Peou,Sandalika Weerasuriya and Tushar Tanwar)

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IDRC CRDI

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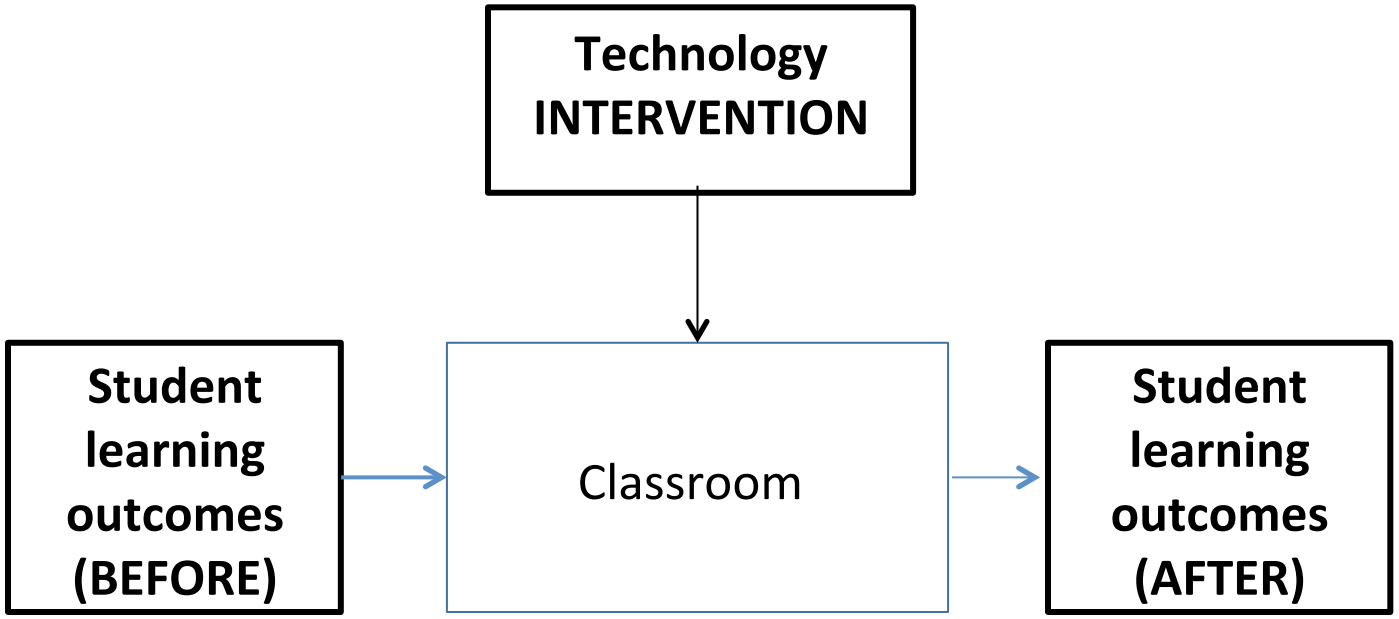
Canada

RESEARCH QUESTION

What makes teachers integrate technology into the teaching–learning process?

BACKGROUND

Integration of technology (ICT) in education promised higher learning outcomes



Gains are modest but expectations remain high

Educational technology is making a modest difference in learning of mathematics. It is a help, but not a breakthrough. However, the evidence to date does not support complacency. New and better tools are needed to harness the power of technology to enhance mathematics achievement for all children."

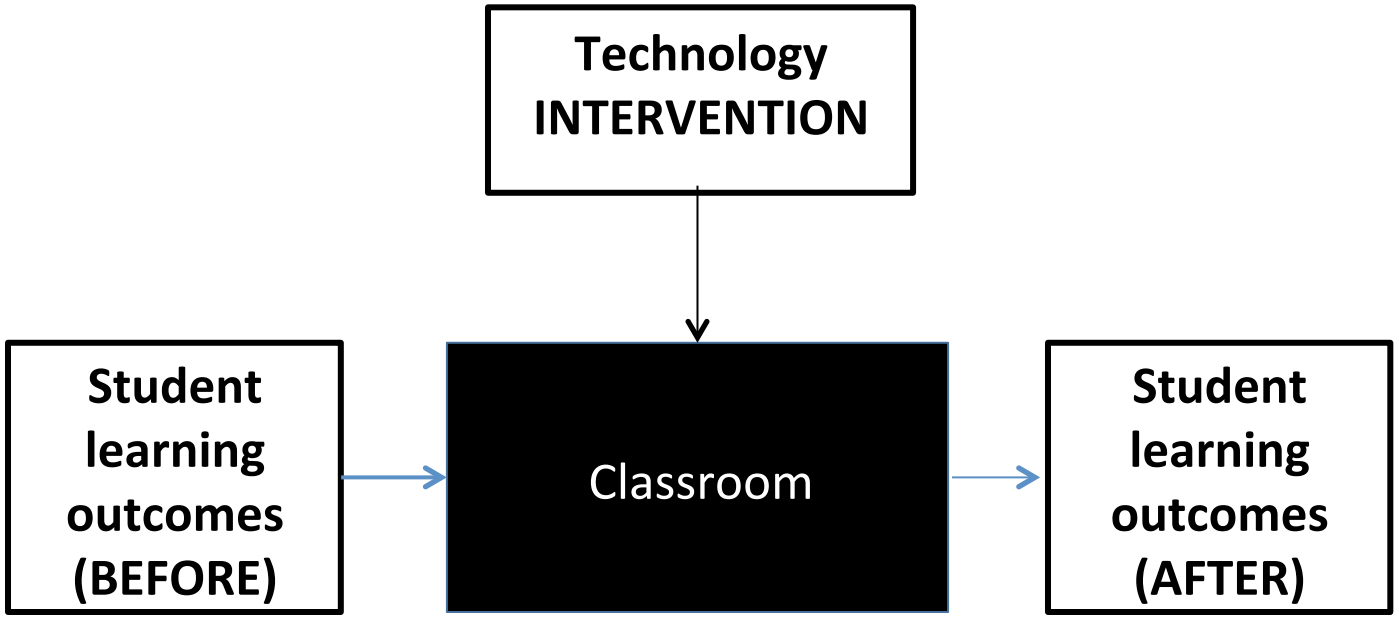
*Cheung, Alan C.K. and Slavin, Robert E. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. Educational Research Review 9 (2013) 88–113.)

Reason: teacher and teaching-learning inside the classroom ignored?

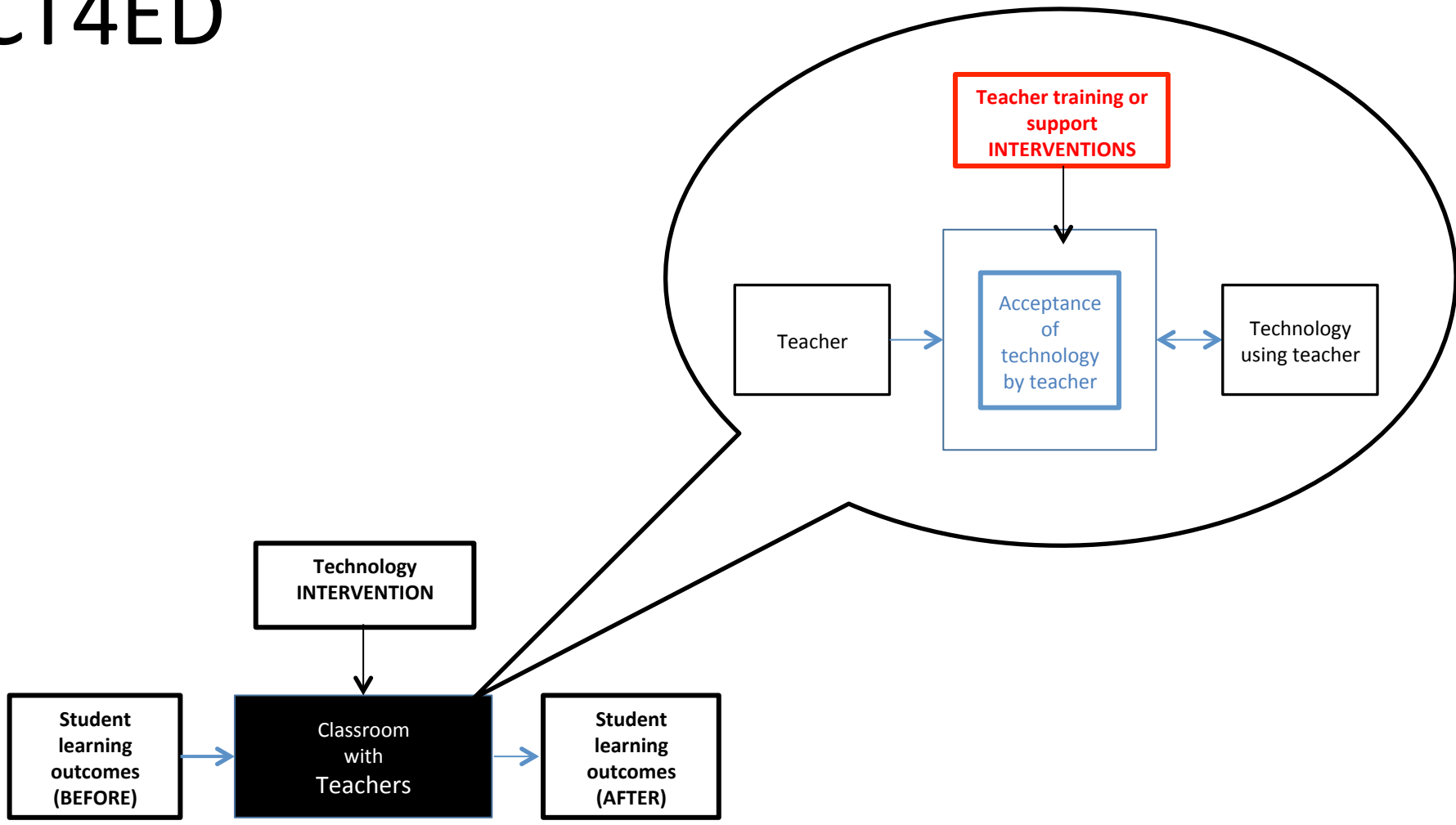
"The evidence suggests that teachers went through the motions as prescribed but did not master the innovation in a way that would have allowed students to get the most of it."

Source: RCT by ADB in Costa Rica (2014)

What happens inside the classroom black-box?



Unpacking the classroom black-box in ICT4ED



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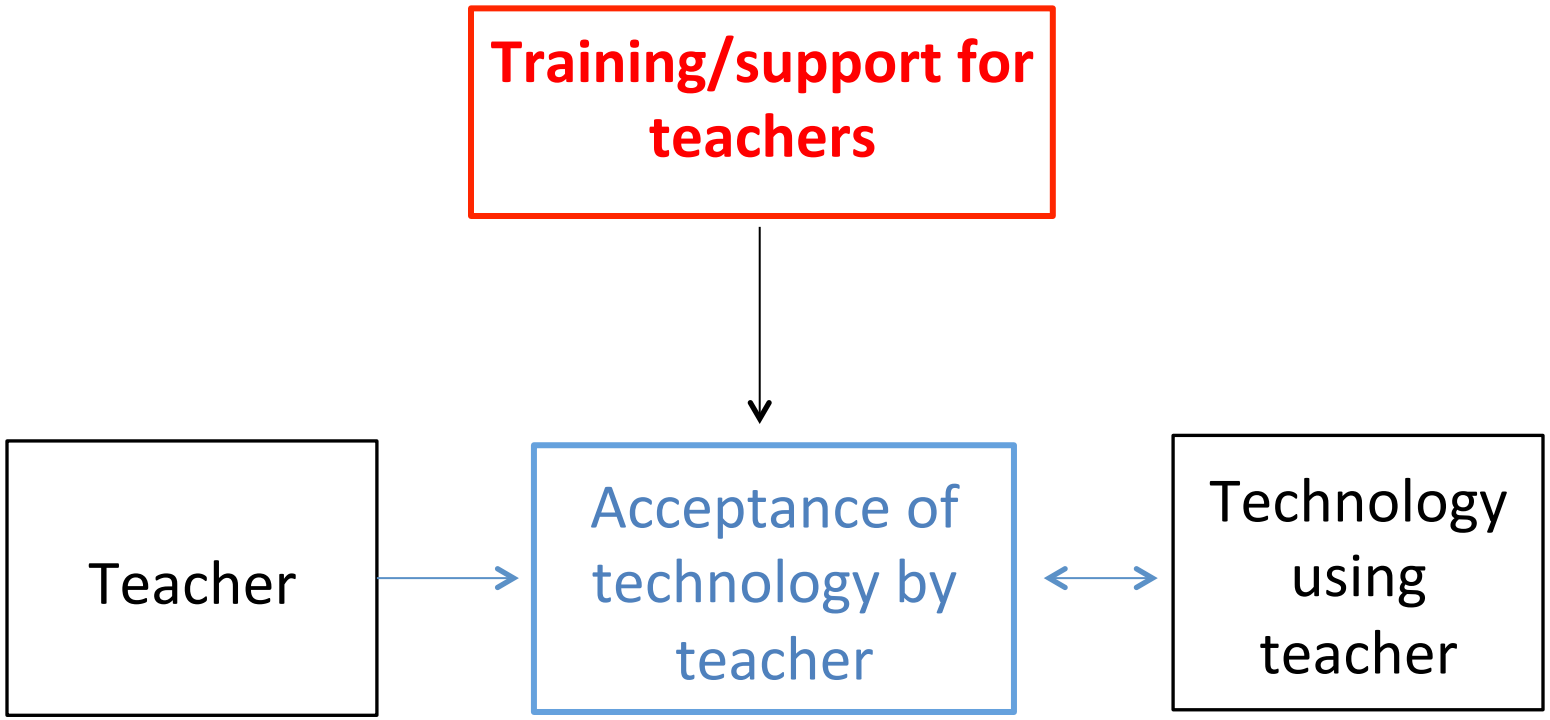
ICT use/integration in the classroom



Theory of change

Teacher training/support

INTERVENTIONS

Technology use

OUTCOMES

Student learning

OUTCOMES

Interventions

- Behavioral — Perceived usefulness and ease of use
- Normative — Perceptions of those important to you
- Functional — Training, support, infrastructure & other

SOURCES:
Technology acceptance model (TAM), Davis, 1986
Theory of planned behavior, Icek Ajzen 1989
Unified Theory of Technology Acceptance ad use (UTTAU), Venkatesh, 2003
Technology, Pedagogy & Content (TPACK)
Innovation diffusion (Complexity, compatibility, relatedness, observabiity)

Outcomes

- Frequency of use
  - Never to daily
- Level of use
  - Teacher use for preparation/presentation/follow-up
  - Teacher guided student use
  - Student use for independent learning in or our of class
- Frequency and level of use

PICOCs

POPULATION	K-12 in-service teachers
INTERVENTION	Behavioral
	Normative
	Functional
CONTROL	Experimental (RCTs)
	Quasi-exptl. (comparables/statistical)
OUTCOMES	Frequency/Level of use
CONTEXT	Year, Technology/Use & Other

METHOD

Systematic review process

- SEARCH — XYZ databases with specific search string*
- SCREEN (1) technology — to include empirical studies concerning use in K-12 classrooms and exclude all others
- SCREEN (2) exclude — to include exptl. or Quasi –exptl. studies and all others
- EXTRACTION — Extract PICOCs for each study
- CODING — Code predictors/outcomes into few categories as possible
- APPRAISAL — Appraise for Risk of bias and
- SYNTHESIS — Calculate effect sizes for category of predictor

Types of bias

- Selection bias
- Confounding variables bias
- Motivation bias
- Performance bias
- Reporting bias
- Type 1/Type II errors
- Other biases

RESULTS

Search results (1990-2014)

- 30,000+ hits
- 2000+ empirical studies on technology use in K-12 classroom
- 100+ Quasi experimental
  - [10] Treatment (with or with out comparison group)
  - [90] Natural experiment (with or with out comparison group)

Most are observation studies of ICT use employing multivariate regressions to ease out effects of different factors

ANALYSIS

via two linked tracks

Quantitative (~100)
Extracting PICOCs and related statistics
Effect size calculation
Synthesis (quant.)

Qualitative (~100+1900)
Extracting PICOCs
Coding
Synthesis (qualit.)

Improved theory of change

INTERVENTION

	SPECIFIC INTERVENTION (school systems)	GENERIC INTERVENTION (Colleges of education, e.g.)
BEHAVIORAL	Usability Usefulness	ICT proficiency & attitudes Pedagogical attitudes
NORMATIVE	School policy	Influence by important others
FUNCTIONAL	Support from the school	Availability of resource, technical support etc.

OUTCOMES

Technology use

Effect size for five intervention categories

		PERSONAL	BEHAVIORAL (technological)	BEHAVIORAL (pedagogical)	NORMATIVE	FUNCTIONAL
1	Abdullah 2013	-	IT knowledgeability SMD 2.81	-	-	Student attitude Ergonomics
2	Brunk 2008	Gender, age, advanced degree, exp.	Personal computer use SMD 0.85	Instructional practices		Poverty, school culture, and principal suppor
3	Fordham 2004	Commitment to teaching	amount of technology training SMD 0.54	openness to change	-	-
4	Hastings 2009	Experience	Proficiency: Productivity Software SMD 0.37 Perceived Benefits of Using Technology.	-	-	-
5	Hefernnen 2012	Personal use, Self-Efficacy, Playfulness,	Skill level SMD 0.39	-	-	-
6	Hermans-2008	Gender	Computer experience SMD – 0.47 General computer attitudes	constructivist beliefs	-	-

Working Hypothesis

Normative/Functional effects > Behavioral effects

If system-wide intervention such as E-books and IWBs which are integral to the curriculum and test taking are implemented with sufficient support for teachers, negative behavioral attributes of teachers, if any, wont matter

Thank you

Improved theory of change

PREDICTORS

Technology is specified

Behavioral

Usability : Complexity, Trialability and Observability

Usefulness: Relatedness, Compatibility

Normative

Influence by important others

Functional

Resources, Technical support etc.

Technology is not specified

Behavioral

ICT skills & attitudes

Pedagogical skills and attitudes

Normative

Influence by important others

Functional

Resources, technical support

OUTCOMES

Technology use

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Extraction worksheet

Paper	Technology	Technology use outcomes			
		Frequency	Level		
Baek_2006		(1) none, (2) rarely, (3) Moderate (4) high—almost weekly per semester	Teacher use/student use	• using the basic functions of technology, • using the enhanced functions of technology • deriving attention • adapting to external requests and others' expectations • class preparation and management • relieving physical fatigue • (TEACHER DERIVED)	Extractors the factors underlying the lay person implicit ideas or beliefs by surveying the users would provide a more authentic and ecologically valid prospect.
Fordham_2004		-1 to 5, with participants' survey responses according to a five-point scale, ranging from "never" to "several times a week."	LOW: Focuses on the teacher using technology to get their job done. MODERATE: Involves teacher facilitation of large group learning activities and student HIGH: productivity use of technology. Promotes students to be actively engaged in using tech. in individual and collaborative learning activities	• openess to change • no. of hours of technology training • no. of hours worked beyond contractual work week	TPCK (Technology factors/ Teacher factors); Technology factors (Marcinkiewicz, 1994; Vannatta & O'Bannon, 2002),
Hastings_20	TPCK/Tiers of Technologyby Washington	never, less than once per week, once per week, 3 times a week, and daily	(1) Teacher-Use of Technology for Delivering Instruction	• Teacher Proficiency: Productivity Software • Beliefs and Behaviors about classroom technology use	TPCK/Tiers of Technologyby Washington State Technology Integration into the

Data entry & calculation

Author/Measure of acceptance or use/ Population/ Sample/ Response/ RoB	Statistics for Teachers' skills and attitudes		
	ICT Skills	ICT Attitude	Pedagogy-Attitude
Abdullah-2013 **Acceptance of E-books (11 items): strongly disagree, disagree, moderate, agree, strongly agree** **Population: 642 Primary teacher Grade 4—6 in two DUNs representing urban and rural DUNs Sura and Rantau Abang** **Sample: random sample by school for 5 schools in Sura and 11 in Rantau Abang** **Usable Response rate: 254/300** **RoB:** **Selection** **Confounding variable**	IT knowledgeability β; p; t; SE=; Sp; v ; Yt, Yc, Ys; nt =nc = ns =254; SDt, SDc and SDY ; ATT RR: 1.13 (0.01) SMD	-	-

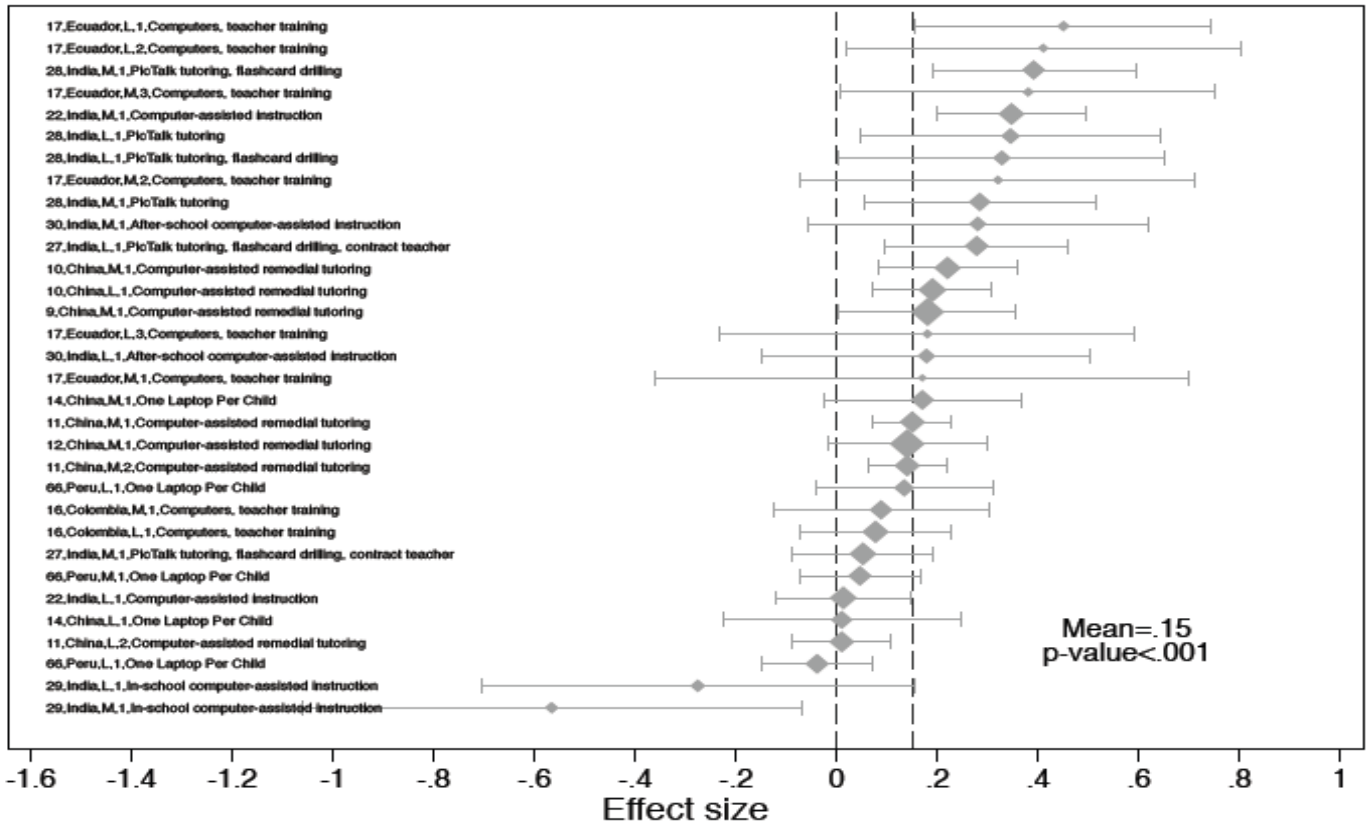
Summary of effect sizes

Studies	Predictors		
	ICT Skills	ICT Attitude	Pedagogy Atitude
Abdullah-2013 **RoB-Low**	IT knowledgeability RR: 1.13 (0.01) SMD		
Askar_ **RoB**	Complexity RR: SMD	-	
Brunk	Personal computer use RR: SMD	-	Instructional practices
Fordham	amount of technology training RR: SMD	-	openness to change
Hermans-2008	Computer experience RR: SMD	general computer attitudes	constructivist beliefs
Hong-Table8-p.62	Computer efficacy	Attitude towars computer technology	-
Hua	Technology literacy	-	-
Pynoo	Effort expectancy	-	-
Rickman-tabe 24, p.109	Software proficiency	-	teaching philosophy
Sanford-2007	-	-	
Sang-2011	Computer motivation	-	constructivist beliefs
Sarfo	-	-	
Skoertz	-efficacy for technology		

Goal

Plots for ICT skills, ICT attitude, Pedagogical attitude, School policy, ICT support (differentiated by technology specificity?); Sample plot below

Figure 3: Effect sizes of treatments with computers or technology



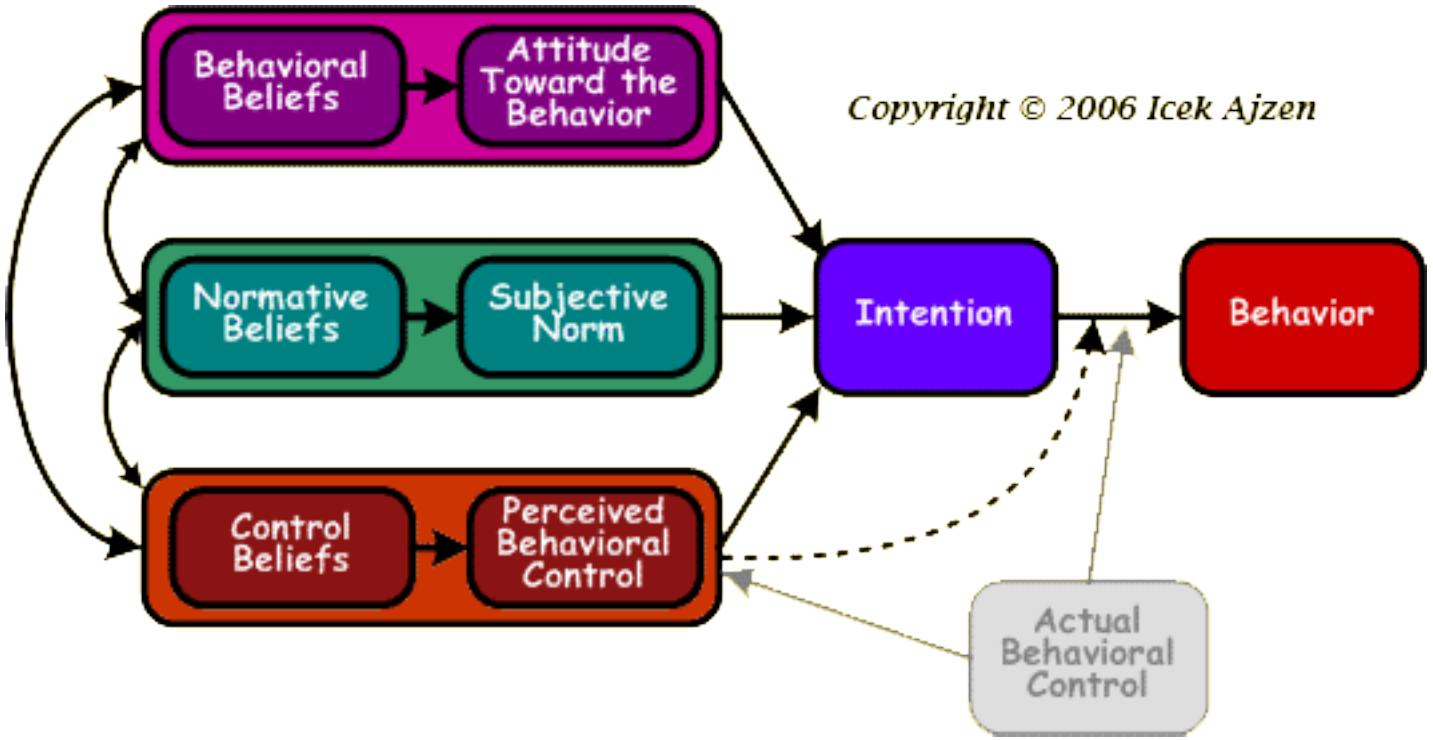
McEwan, 2014

Predictor1: ICT efficacy

Paper	Descriptor/Definition	Code
Abdullah_2013	IT Knowledgeability	
Askar_	Complexity	
Brunk	LOTI-Personal computer use	
Fordham	amount of technology training	
Herman	computer experience,	
Hong-Table8-p.62	Computer efficacy	
Hua	Technology literacy	
Pynoo	Effort expectancy	
Rickman	software proficiency	
Sang-2011	Computer motivation	
Skoertz	efficacy for technology integration	
Stols	beliefs about their level of technological proficiency	
Teo	teachers' computer efficacy	
Tondeur-2010	perceived expectancy of success	
Van Acker	ICT skills was in its turn the strongest predictor of self-efficacy.	
Van Braak	computer experience (computer training, computer experience expressed over time, intensity of computer use)	
VanderLinde	ICT competences	
Ward-2010	confidence in ability to use technology in the classroom, with self-efficacy	
Yucel	'ICT knowledge of teachers	

Theory of Planned behavior

Icek Ajzen (2006)



Unified theory on technology acceptance and use

UTTAU (Venkatesh , 2003)