

Using Technology and Mentorship to Improve Teacher Pedagogy and Educational Opportunities in Rural Nicaragua

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Abstract

This study used ethnographic methods to understand factors influencing the implementation of an educational intervention combining short math content videos with teacher training and mentorship in high-poverty primary schools in Nicaragua with implications for rural school reform. Educators in rural schools in Latin American face serious obstacles to improve classroom instruction and pedagogy, including lack of resources and overcrowding. Research suggests an over-reliance on input-output models in which inputs (e.g. teacher salaries, textbooks, technology, computer labs, numbers of classrooms, etc.) are expected to produce particular outputs (student retention, lowering drop-out rates, increasing graduation rates, etc.); however, studies show that regardless of the resources, much depends on effective use of resources for successful teaching and learning (O'Sullivan, 2006; L. S. Shulman, 1987). While input/output models provide insights into an educational systems' economic efficiency, they do not offer insight into what actually transpires inside of a classroom (O'Sullivan, 2006). Much depends on effective training and use of available resources. Though systemic issues in the Nicaraguan educational system produced numerous obstacles for the eleven participating 3rd and 6th grade teachers, the educational intervention model supported teachers' ability to be innovative and grow their practice in four ways: a) increased pedagogical knowledge; b) number of opportunities to collaborate and support one another as a community of teachers; c) flexibility in adaptation of the intervention model to their specific classroom context; and d) use of videos as supportive resources for content knowledge.

Keywords

Teacher education, math content videos, Nicaragua, pedagogical content knowledge, teacher training, mentorship, rural school reform

Introduction

When Nicaragua's Sandinista National Liberation Front (FLSN) overthrew the Somoza dictatorship in 1979, they inherited a country with a number of severe problems, including the largest per-capita debt in Latin America, infrastructure devastated by war, and almost 40,000 orphans in a country of 2.5 million (Hirshon & Butler, 1983). The new government's highly publicized priority was a countrywide focus on education including a literacy campaign, an increased education budget, and the construction of schools in rural areas (Arnové, 1995). Although access to primary school education has greatly increased in the intervening years, educational quality is still a struggle. The Ministry of Education in Nicaragua estimated that of the 93% of children enrolled in primary school, only 43% of them finish the 6th grade, and of those only 41% go on to enroll in secondary school (*Plan estratégico de educación 2011-2015*). A significant percentage of teachers—more than 60% in 1995—are *empíricos*, or untrained when they begin teaching (Arnové, 1995) and the average teacher in Nicaragua earns around \$185–\$226 a month (Rogers, 2012). Issues of teacher shortage are exacerbated by the poverty wages paid to teachers. *Escuela normal* (teacher education for high school graduates) and teacher education programs at universities struggle to attract sufficient teachers to meet the needs of the public schools (Vegas, 2007). Consequently, in-service teacher education is particularly relevant as a means of changing teacher practices and improving schools.

Theoretical Framework

We understand teacher practices through a sociocultural lens, in which change and growth are mediated by the social, cultural and historical context (L.C. Moll, 1990; Rogoff,

Nicaraguan educators and education-advocates have begun to explore new solutions to these historical problems. However, Fuller's (1987) description of the state of research in the developing world still largely holds true:

Few observational studies within Third World classrooms have occurred. To date this work tends to be atheoretical ... the school effects literature from the U. S. and Europe suggests a variety of research avenues related to the social organization of schools and classrooms. But these roads have yet to be traveled by investigators working in developing countries. (p. 288)

In this article, we address a dearth of research around the pressing issue of improving school quality in resource-poor contexts like Nicaragua. We focus on the in-service development of practicing teachers to identify and describe Nicaraguan teachers' responses to a pilot educational intervention consisting of math content videos, mentorship and ongoing professional development. Our central purpose was to explore the ways in which teachers adopt, adapt, or resist outside interventions, to begin to understand the complexities of teacher development in contexts like Nicaragua, and better inform future efforts to improve teaching and learning in similar contexts. Our two guiding research questions were:

1. What factors prevented teachers or encouraged teachers to take up new ideas in this high-poverty context?
 2. How did participation in an educational intervention impact teacher innovation and the development of teacher practices?
- (2003; Vygotsky, 1978). Drawing on this perspective, we recognized teacher innovation as

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a collaborative process. Teacher growth occurred in part through interactions with colleagues, mentors, and additional educators mediated by the rural, high-poverty educational context.

A sociopolitical lens reveals the ways in which social, economic, or political forces reward or punish teachers (Apple, 1990; 2004; Giroux, 1998); however, our work built on the assumption that teachers are agents of change, and this change can transpire through dialectical partnerships and collective struggles for humanization (Campano, Honeyford, Sánchez, & Vander-Zanden, March 2010; Freire, 2007).

Given this theoretical socio-cultural grounding, all three researchers aimed to collect data that centered on and valued the participating teachers' perspectives and knowledge. Interactions between the researchers and teachers during professional development aimed to collect, organize, and analyze local knowledge between schools. All three researchers explicitly tried to position themselves as learners in the interactions alongside an evaluative role. When researchers noticed or recognized an area for professional development (i.e., incorporating a collaborative learning technique), strategies drawing on cognitive coaching were used to ask teachers first what they thought and then have teachers reflect on their own teaching practices (Costa & Garmston, 1994; Ellison & Hayes, 2013).

This work also draws on theories of pedagogical content knowledge (PCK) (Carpenter, Fennema, Peterson, & Carey, 1988; Mishra & Koehler, 2006; Shin et al., 2009; L. S. Shulman, 1987), which posit that there is a difference between awareness (basic recognition) and knowledge, a deeper understanding that is situated, connected, and more specific. Teacher pedagogical content knowledge and teacher cognition are entwined and important to explore in teacher education (L.S. Shulman, 1986; L. S. Shulman, 1987). One

of the central aims of this study was to examine teacher perceptions regarding the relationship between this educational intervention, and their own growth in pedagogical content knowledge.

Our findings and discussion pay particular attention to the ways teachers navigate both curricular knowledge—materials for teaching and context for teaching—and the constraints around the particular programs or materials that are mandated (L. S. Shulman, 1987; Lee S. Shulman, 2004).

Review of the Literature

Given the extremely limited amount of empirical research conducted in Nicaragua, we considered research on in-service teacher education conducted in Latin America and other countries in the developing world. However, this was done with the awareness that countries do not fall easily into a dichotomy of developing/developed, and that there is huge variation between countries that may be categorized as developing. To that end, we looked to research on teacher learning in Latin America, as well as some meta-analyses that considered multiple countries with similar challenges.

Since 1990, the Nicaraguan government's educational reform initiatives have focused on improving educational quality through decentralizing education management and changing teachers' classroom practices (Bruce Fuller & Rivarola, 1998; MECD, May 14, 2002, September 6, 2006). Today all managerial and budgetary autonomy is in the hands of school based councils (*consejos directivos*). These decentralization initiatives have promoted active-learning pedagogies based in constructivist notions of teaching and learning (Edgerton, 2005; MECD, September 6, 2006).

One of the primary challenges in contexts like Nicaragua is that of access, specifically the ways in which institutions and policies attempt

to ensure that students have equitable opportunities to quality education. In Nicaragua broad swaths of the population have extremely limited access even to primary schooling characterized by lack of access to facilities, qualified personnel, books, technology, supplies, and transportation to school (Angel-Urdinola & Laguna, 2008). Teachers in similar contexts in other parts of Latin America also face complex challenges such as teaching children in multi-grade classrooms (M. T. Totto, 1999). Rural teachers in particular are isolated from in-service teacher education and this professional isolation leads to high rates of absenteeism and turnover (M. Totto & E., 1997). Moreover, as has been noted elsewhere in the developing world, debt servicing and fiscal austerity measures imposed by organizations like the International Monetary Fund have often been linked to reductions to the educational budget and declines in teacher quality (Arnové, 1995; Vegas, 2007).

The systemic barriers of teaching in Nicaragua were also illuminated through an additional interview with researcher, educator and local educational advocate, Josefina Vijil. She recognized teacher retention and quality as a problem exacerbated by the positioning of the profession. Vijil said:

People here become teachers for the sole reason that they're poor. They opt for teaching as a quick solution, because there are no technical education options to help them get a job. If they fall in love with teaching they'll carry on, but if not they'll find another job as soon as possible, or else go to Costa Rica where they can earn more working as housekeepers. (Vijil Interview, 8/15/2012)

Teaching has become a profession for women in poverty. Yet, because the demand for teachers has increased, teacher certification has

become more relaxed and many teachers are responsible for teaching content that they themselves never learned in school (Elvir, Vijil, Castillo, & Castro, 2006; Vijil, 2008). According to a qualitative study by Naslund-Hadley, Loera-Varela, and Hepworth (2014) on cross-country differences between Paraguay, the Dominican Republic, and the Mexican state of Nuevo Leon, the years of teaching experience, training, and pedagogy, in addition to the socio-economic background of the students and schools, influenced student achievement scores on the Second Regional Comparative and Explanatory Study (SERCE). Employing poorly prepared teachers can result in actively teaching misinformation, exacerbating existing problems. The study found that teachers who had university degrees worked in schools with students that had higher achievement on their SERCE (Naslund-Hadley et al., 2014).

Given constraints, education systems in the developing world, including Nicaragua, have tried a wide variety of strategies. Vegas (2007) synthesized research across many developing countries, finding a general trend in which increases in educational funding in general, and teacher salaries in particular, were correlated with increased student achievement. When Brazil increased educational funding substantially and distributed resources more equitably, student enrollment increased in poor areas, and the gap narrowed between high and low-performing students in achievement on standardized tests. This shift in resources was also associated with fewer over-age students, indicating that students were repeating less and/or were less likely to drop out and re-enter at a later age.

Teacher performance pay initiatives in Bolivia, Mexico and Chile offered inconclusive evidence, though claiming that money distributed significantly affects outcomes (Vegas, 2007). Vegas also noted that devolving authority

to local schools in El Salvador and Honduras lead to less teacher absenteeism and better parent-teacher relationships, although it did not seem to be directly tied to student achievement outcomes.

In a more recent meta-analysis of research on education in the developing world, Buchmann and Hannum (2001) noted that although spending more on science labs, reducing class size or teachers' salaries did not seem to increase student achievement, there was strong evidence that spending more on textbooks, libraries and teacher education matters and strongly affected student outcomes. This led them to conclude that in developing countries, basic material inputs and teacher quality are highly important; much more so than in industrialized countries where these factors may be assumed to be widely available. However, the authors did note that recent studies tend to rely on measures like the TIMSS (Third International Math and Science Study) test, and the poorest countries, such as Nicaragua, generally do not participate in TIMSS.

The meta-analysis conducted by Hanushek (1995) indicated that teacher education was a significant and key factor in improving student performance in developing countries, more so than teacher salaries, student-teacher ratios, or per-pupil expenditures. However, reviews of teacher education in the developing world have indicated that teacher education in this context was under-theorized, meaning practice was not up to date with current research on effective pedagogy, and that teachers' practices did not seem to be effective, leaning towards rote memorization (Navarro & Verdisco, 2000). Moreover, there are serious critiques of teacher preparation programs in Latin America as a whole, claiming that the educational theory taught is divorced from practice, and that teachers are not prepared to teach in rural settings or with indigenous

populations (Villegas-Reimers, 1998).

Additionally, many teachers, especially rural teachers, do not have many opportunities to participate in in-service professional development. Teachers interviewed in several research studies often mentioned the need to have more practical in-service courses (Navarro & Verdisco, 2000).

Since teachers in contexts like those described above may find their way to teaching through many different routes, there has been a general trend towards increased focus on in-service rather than pre-service teacher education. This trend likely reflects widespread criticism that teacher education programs at universities are impractical and disconnected from the realities of daily teaching. However, in Nicaragua and much of Latin America, hours of in-service teacher education are often directly linked to salary increases and career advancement. This has created a pressure away from high quality in-service education, as the incentive is for teachers to accumulate credentials and diplomas, and learning or change in practice is incidental (Navarro & Verdisco, 2000).

In Mexico, Tatto (1999) highlighted one recent example of an in-service program that aimed to change teachers' practices in order to better reflect constructivist theories of teaching and learning. Previous to this initiative, all in-service education had been provided at "Teacher Actualization Centers" run by the government. These centers had low attendance rates and were widely criticized for didactic teaching methods and lack of curricular coherence. In *El Programa para Abatir el Rezago Educativo* (PARE) [Program to Avoid Falling Behind Educationally]; local teams in the four poorest Mexican states submitted proposals, and were given materials and training in Piagetian developmental theory and constructivist teacher methods. This program was judged successful on

some accounts, in particular adjusting the curriculum to better reflect the needs of indigenous students and rural teachers. However, Tatto (1999) noted the ways in which PARE did not achieve its stated goals; namely, teachers were taught via a “cascade model”, with a small cohort of teachers participating in an initial training, who then returned and taught colleagues. This did not prove to be an effective way of disseminating constructivist methods, perhaps because the initial training was carried out via traditional direct instruction. PARE was also not able to address weak subject-area knowledge; since, as the author acknowledged, “improving one’s poor knowledge of subject matter requires long periods of sustained study and guidance---something the program could not readily provide” (p. 28). Tatto argued that the urgency for fast and massive reforms in Mexico may have led to superficial implementation of teacher education reform and compromising of the goals.

Research on teaching highlights the variability in how teachers understand and enact new reform ideas in classrooms (Cohen, 1990; Spillane, 1999). The intervention described in this study provided in-service teacher education that emphasized cooperative learning and the use of math content videos. The professional development opportunities were structured to place the teachers as experts, learning from one another and fostering collaboration. In Nicaragua, as elsewhere, the most common professional development follows a model of direct instruction in “best practices” (Campano et al, 2010) when a ground-up educational approach to reform may actually serve better to empower teachers and students (Campano et al., March 2010; Freire, 2007).

Relevant to this study is how teachers adopt and use math content videos, which in the context of Nicaragua, requires resources not readily available to teachers because of a lack

funding. Literature on international donor communities suggest that there continues to be a disconnect between global visions of educational equity and quality with an over-reliance on input-output models (Sanyal, 2009). However, studies show that regardless of the resources, much depends on effective use of resources for successful teaching and learning (O’Sullivan, 2006; L. S. Shulman, 1987). For example, distribution of laptops to children does not guarantee that the children will develop computer literacy (Owston & Wideman, 2001). Lack of educational software or inexperience with the technology can result in student and teacher frustration or confusion (Owston & Wideman, 2001). Evidence suggests that teachers need substantial amounts of time to learn how to integrate approaches using technology in their classrooms (Owston & Wideman, 2001). While input/output models provide insights into an educational systems’ economic efficiency, they do not offer insight into what actually transpires inside of a classroom (O’Sullivan, 2006). This intervention incorporated ongoing professional development and mentorship for participants. In this study, we took into consideration both our observation of classroom practices and teacher accounts of participation in the intervention, specifically how they integrated (or did not integrate) math content videos into their instruction, and how they judged that their participation in the intervention mediated their pedagogical content knowledge.

Methods

Data Collection and Analysis

In order to understand teachers’ experience of a technology-based math pedagogy intervention and how it mediated their teaching practices, we used qualitative methods. We sought to understand how participation in this

intervention facilitated changes in teacher practices both through teachers' perceptions and experiences of their own learning and observations of teachers in action. To understand teachers' experience of the program, we conducted semi-structured interviews with all of the participating teachers, the mentor that visited them as part of the intervention, and administrators at two participating sites. These semi-structured interviews included questions that were open-ended in nature and asked teachers to reflect on their experiences in the classroom, at their school, with the content, collaborating with other teachers and their mentors, and as participants in the intervention. These semi-structured interviews (See Appendix A for interview questions) were conducted bi-monthly over the course of three months (July, August, and December of 2012).

We triangulated teachers' experience and description of their practice with observations of teachers in action. All researchers spent three weeks observing teachers across all of the participating schools. As participant-observers, the researchers entered the classrooms, established relationships and participated in teacher workshops during a three-week period.

The jottings taken in the field during observation were later expanded into full fieldnotes (Emerson, Fretz, & Shaw, 1995). In order to extend understanding of teacher practice, these observations were contextualized by the semi-structured interviews with administrators, the teachers, and mentor. We also drew on relevant artifacts such as observation records kept by the teacher mentor and teacher lesson plans.

During the initial round of coding (See Appendix B for codes), researchers read the entire data set and generated a set of preliminary or "in vivo" codes (Glesne, 2006), periodically writing analytic memos to make

sense of emerging themes (Saldaña, 2012). These analytic memos served to help refine and collapse initial codes into categories and subcategories. All video and field notes were coded collaboratively (Adair & Pastori, 2011). After initial coding, researchers revisited the original data set to selectively transcribe teacher interviews. Data was triangulated (Marshall & Rossman, 2011) and repeatedly revisited to find patterns, examples and counter-examples using an inductive approach to analysis (Glesne, 2006; Marshall & Rossman, 2011; Mertens, 2005).

Participants and Schools

The professional development intervention involved eleven teachers (third and sixth grade) and two administrators at five different high-poverty primary schools in Nicaragua serving approximately 350 third and sixth grade students combined. On average, there were 27 students per classroom. The teachers and schools were recruited to participate in the program by the sponsoring non-profit organization, *Fundación Uno* through their existing networks. Participation was voluntary, and ultimately the teachers and schools selected by *Fundación Uno* were formed through mixed purposeful sampling based on homogenous grouping factors, convenience, and criteria (Emerson et al., 1995). More 3rd and 6th grade teachers volunteered to participate; thus, the organization narrowed down participation to the five schools that had both a 3rd and a 6th grade teacher.

The participating teachers each came to their schools with a variety of educational experiences, some having attended teacher-training programs upon high school graduation known as *escuela normal*, while others held a Bachelors or Masters degree. Pseudonyms have been used to protect teacher and school privacy.

Table 1
Participating Teachers

Teacher	Position	School	Years of Experience	Preparation
Mari	3 rd grade	Savir	24	Teacher Training for high school graduates/ <i>Escuela normal</i>
Yvette	3 rd grade	Savir	29	Teacher Training for high school graduates/ <i>Escuela normal</i>
Tania	6 th grade	Savir	15	Teacher Training for high school graduates/ <i>Escuela normal</i> Certified/ <i>Diplomado</i>
Erica	6 th grade	Savir	12	Teacher Training for high school graduates/ <i>Escuela normal</i>
Fabiola	3 rd grade	Alivah	5	Teacher Training for high school graduates/ <i>Escuela normal</i>
Laurita	6 th grade	Alivah	5	Working towards Bachelors/ <i>estudiando licenciatura</i>
Miriam	6 th grade	Clara	29	Teacher Training for high school graduates/ <i>Escuela normal</i>
Leticia	3 rd grade	Clara	16	Bachelors/ <i>Licenciatura</i> Masters/ <i>Maestría</i> Doctoral student/ <i>Estudiando doctorado</i>
Jecenia	3 rd grade	Tambra	18	Bachelors and Teacher Training school/ <i>Licenciatura and Escuela Normal</i>
Ana	3 rd grade	Julio XXXIII	4	Teacher Training for high school graduates/ <i>Escuela Normal</i>
Elena	6 th grade	Julio XXXII	24	Bachelors and Teacher Training school/ <i>Licenciatura and Escuela Normal</i>

Table 1

*All names are pseudonyms

All teachers were mentored and coached by Bella, an employee of *Fundación Uno*. Bella is a native Nicaraguan currently working on her MA of Education. She observed teachers at their schools once a week and conferenced with them after each formal observation over the course of the school year. During this time Bella would

take on a variety of roles, that of a classroom observer, that of an actively participating student, or even that of a co-teacher. Additionally, Bella led a professional development training/ teacher meeting for the teachers involved in the project once a month. Her multi-layered perspective on education

based on her own schooling experiences in Nicaragua, combined with her advanced technological skill-set made her an important asset to the intervention.

The five schools served similar populations in terms of low-income students from rural communities. While all schools had access to content videos, it is important to note that they accessed these videos through very

different means. At one school, Savir, each student had a One Lap Top Per Child (OLPC) XO laptop and USB video files. The other four schools used TV carts, DVDs, USB video files, and/or their computer labs. In three schools, Tambra, Clara, and Julio XXXII, teachers did not have televisions in their classrooms and consequently needed to negotiate the use of a common television.

Table 2
Participating Schools

School	Grade Level	Technology to Access Content Videos	Details
Savir	PreK-Secondary	OLPC XO computers/ USB memory sticks of content videos	Catholic nuns manage the school and work with salaried non-religious teachers/ staff. Lunch provided.
Julio XXXII	PreK-6	Television/ DVD	Independent private school funded by several non-profit organizations. School provides education to low income children from surrounding areas and parents pay a nominal fee of C\$35 a month (US\$1.50). Low teacher salaries below the national average.
Alivah	PreK-6th	Television/ DVD	40 km from the capital in a low-income rural area. Inhabitants live off of mostly subsistence agriculture. Private Christian organization/school mostly funded by a church in Seattle. Breakfast and lunch provided
Tambra (Morning classrooms) / Clara (Afternoon classrooms)	PreK-6th	Television/ DVD (borrowed from principal's home upon teacher request)	Parochial Catholic School located in El Crucero, in Managua. Students are from low-income households, as well as students who have been unable to continue studying in neighboring private schools due to poor performance or learning difficulties. Children pay a small fee for attending.

Table 2

The Educational Intervention

In 2006, the Khan Academy, a non-profit organization in the United States created a free online education platform with over 3,000 math and science video tutorials ("Khan Academy Math," 2015). These video tutorials were created using recorded audio of direct instruction paired with screen-casting technology of an electronic blackboard to capture a teacher using their whiteboard to provide instruction ("Khan Academy Math," 2015). The videos provide short segments of step-by-step instruction incorporating formulas, equations, doodles, and diagrams to show multiple ways of solving math problems. Khan Academy videos can be viewed by students independently, can be used by teachers to flip the classroom, or can be used as a foundation for scaffolding other opportunities for guided, collaborative, and/or independent practice. The organization's website also provides a progress tracking platform, practice exercises and other resources for educators.

The Khan Academy educational platform has attracted widespread attention for its potential to provide high-quality content instruction, and inspired *Fundación Uno* to pilot an educational intervention centered on math content videos to be viewed by teachers and students using donated televisions and DVD players or One Laptop per Child (OLPC) XO computers. *Fundación Uno* paired the math videos with a series of professional development opportunities and weekly mentorship. The 300 math videos were selected because they met the Nicaraguan content standards for third and sixth grade (e.g. arithmetic operations, multiplication, fractions, decimals, measurements, etc.). Of the videos selected, some had already been translated into Spanish by the Khan Academy while others were translated by *Fundación Uno*. Combined with teacher trainings, the intervention sought to improve teacher pedagogy while increasing student academic success in math. *Fundación Uno* designed,

funded, and implemented the educational intervention. The researchers collected, analyzed, interpreted the data, and wrote the research report independently.

Teachers at participating schools took part in a one-week intensive professional development at the beginning of the school year designed to support the growth of their pedagogical content knowledge. To this end, they were supplied with math content videos, which were drawn from the Khan Academy video collection. The videos consist of short segments of direct instruction on a wide variety of math topics. Bella, the teacher mentor, and program facilitator reviewed and organized all of the videos in order to align them with the Ministry of Education's scope and sequence for 3rd and 6th grade. As part of the training, Bella introduced a number of interactive activities and lessons to complement the videos. Following the training, she visited each site weekly to observe and coach teachers in their math instruction. Bella also provided regular teacher trainings and collaborative lesson planning opportunities throughout the school year. She specifically focused her coaching and professional development on lesson structures and activities that were interactive and participatory. This stemmed from her observation that math instruction as a whole tended to primarily consist of traditional methods in which students copied algorithms from the board and solved (or failed to solve) them independently.

A Note on Researcher Positionality

All three researchers spoke Spanish fluently which facilitated data collection and rapport with participants. Researcher one is a White female who was raised in Nicaragua which provided additional knowledge of local culture and customs. Researcher two is a White female who taught and lived in Mexico for five years and researcher three is a Latina female. All three researchers were hired by *Fundación Uno* for

the purpose of evaluating the intervention. While this created the potential for a possible conflict of interest, researchers explicitly told the organization they would report both positive and negative findings of the intervention prior to agreeing to participate in the evaluation. Given that the project was a pilot for a larger scale intervention, the researchers felt welcome to notice and describe challenges and failings as well as successes.

Findings

Teachers perceived that systemic issues in the Nicaraguan educational system, such as low salaries and lack of resources, produced numerous obstacles for their professional growth and use of educational intervention. Educator buy-in and the intervention model itself further influenced the ways teachers took up (or did not) aspects of the intervention. Amidst these conditions, we identified several findings, which indicated that the educational intervention model supported teachers' ability to be innovative and grow their practice. Salient among these findings was: a) teachers reported increased pedagogical knowledge from participation in teacher trainings and program mentorship; b) teachers appreciated increased opportunities to collaborate and support one another as a community of teachers; c) teachers were flexible in adaptation of the intervention model to their classroom context; and d) teachers perceived the videos as valuable and supportive resources for pedagogical content knowledge.

Conditions Mediating Teacher Innovation *Systemic Barriers*

Several teachers expressed the sentiment that they were being taken advantage of by the educational system in which they worked, negatively impacting their motivation for participation in the intervention in particular and in professional development generally.

Numerous teachers expressed the sentiment that they were not treated like professionals. For example, due to budgetary issues, accounting problems, and government corruption, teachers at one school explained that they did not receive paychecks for multiple consecutive months.

There is a clear connection between systemic barriers and teachers' motivation to improve their practice and content knowledge. Teachers described how their inconsistent salary payments lowered their motivation to participate in the intervention because under those conditions "*no tienes ni un sentido*" [you don't feel anything] (Jecenia Interview, 8/2012).

Bella, the teacher mentor and program coordinator, also perceived the impact of the working conditions and broader context on teachers' motivation to learn:

They haven't gotten paid ... I feel like they don't really have any motivation to change what they've been doing because they're kind of like, 'You should be glad that I even come!' so to take the extra time to put DVDs and watch them and plan a lesson and try to change their teaching completely, I feel like they don't have the motivation. (Bella Interview, 6/13/12)

Bella noted that there was a "combination of reasons why" the implementation of the intervention was challenging, but then described how "other problems" including how larger structural issues further influenced the teachers' motivation to participate in the intervention. Aware of the relationship between the economic conditions and teacher attitudes, Bella also noted that Nicaraguan teachers are not only the worst paid teachers in Central America, but they are also among the worst paid professionals in Nicaragua, earning less than 60% of the average wages for other jobs (Rogers, 2012). Teachers' consciousness that they were not accorded respect or compensation as professionals

seemed to negatively impact their desire to participate in professional development.

Importantly, economic constraints and other structural problems were not always associated with low motivations. Some teachers expressed a high commitment to their own professional growth alongside regard for the importance of teaching to the community. For example, Fabiola, a teacher at Alivah, noted, “*Aquí no es un salario muy grande, tenemos que reconocer que es un proyecto social y estamos limitados a lo básico.*” [Here, the salary is not big. We have to remember that this is a social project and we are limited to the basics] (Fabiola Interview, 8/2012). Here, she acknowledged that teaching was not well-paid, but noted its importance to society. Thus, despite the structural barrier of low-pay and missed payments, teacher commitment to education as a form of social work mitigated, in multiple cases, the negative impact on teacher motivation.

Intervention Ownership

Teachers articulated a lack of ownership that created difficulty in implementing the new teaching practices introduced as part of the intervention. In several cases, teachers did not feel they were in control of the resources or decisions regarding their practice. For instance, a common sentiment expressed by teachers was a sense of lack of control over the grade level they were asked to teach. For example, one teacher noted that she felt particularly disenfranchised when, after 25 years of working as a pre-K teacher, she was switched into a 6th grade classroom by her administration despite her reservations and protests. At the time of the study, she perceived this change to be a significant barrier to her development of pedagogical content knowledge. She expressed that prioritizing learning the content of the sixth grade curriculum prevented her from focusing on issues of pedagogy.

Although several teachers attributed similar lack of ownership and autonomy as obstacles to their professional growth, teachers who valued the intervention described themselves as better positioned for innovation and development. For instance, Jecenia regarded the intervention as an opportunity to grow her practice and empower herself as an educator.

Se ha interesado por darle armas al maestro con que defenderse, con que pelear la batalla. Y lo más interesante es que no estoy pagando ni un costo. Eso es el logro mas grande, yo no estoy pagando nada solo poniendo mi disposición. [It has interested itself in giving teachers the weapons to defend themselves, with which to fight the battle. And the most interesting thing is that I’m not paying a thing, there is no cost. That is the biggest gift, I am not paying, only putting myself forth]. (Jecenia Interview, 8/2012)

Jecenia associates being a teacher in Nicaragua as being in “*la batalla*” [a battle]. She powerfully depicts the tools she receives from the intervention as “*armas*” [weapons] with which to fight. Teachers who perceived professional development as a useful tool for their own purposes sought authentic and deep changes in their classroom tasks and discourses (Spillane & Jennings, 1997). Jecenia proudly admits that although many of her nephews studied at the university, she was the first of her family. “*Saqué una doble carrera en pedagogía y administración escolar*” [I double majored in pedagogy and school administration]. Though she studied to be a principal, she explained that she feels called to the classroom instead by, “*ese sentimiento, te enamoras*” [That feeling, you fall in love with it]. Strong identification with teaching and a professional identity as a teacher contributed to her interest and ability to try out new teaching practices (Ladson-Billings, 1994).

Another teacher, Leticia, similarly valued the intervention as a useful tool, and welcomed visitors into her classroom. She asked for suggestions towards her development as a teacher. She believed that feedback is key to growth (Leticia Fieldnotes, 8/2012), and expressed an interest in pursuing her growth in pedagogical content knowledge. She perceived teacher education as an investment in herself and in her students, and consequently saw the math content videos as a tool for her own use.

Mentorship

Mentorship was identified as an important and helpful process by all of the teachers participating in the intervention. This observation is consistent with the literature that highlights the need for interventions in developing countries to go beyond an input-output model to provide guidance for implementation (O'Sullivan, 2006; Sanyal, 2009; L. S. Shulman, 1987). Teachers spoke highly of Bella's mentorship. In a rural, high-poverty context with multiple systemic barriers, two aspects of Bella's mentorship style were central to her success: a) co-construction of knowledge; and b) hands-on intervention.

Bella valued the knowledge of the local participating teachers and approached her mentorship as a facilitator to co-construct knowledge and pedagogical growth. For example, during both the initial teacher training and on-going professional development, Bella co-constructed activities with the teachers to supplement the math content videos. In other words, rather than tell the teachers what to do when showing a specific video, she facilitated the discussion through cognitive coaching to have teachers come up with activity ideas on their own (Costa & Garmston, 1994). Teachers turned paper bags into *Bolsitas de Tesoro* [treasure bags] filled with multiplication problems for student independent practice, empty cereal boxes into game boards, repurposed trash into

classroom corner stores with prices, and old take-out menus were repurposed and used to simulate the dining experience and paying of bills. Bella served as an intermediary to share these ideas across school contexts.

Bella's hands-on approach to mentorship also appeared to facilitate her success. As noted, teacher training and professional development generated ideas that could be directly applied to the classroom. Bella then was a participant observer in each teacher's classroom. The degree to which Bella participated in a teacher's classroom varied based on individual teachers' needs. In some classes, Bella took over the lesson completely to model an activity, while in other classes she took a more peripheral role, only stepping in when the teacher requested. In all cases, Bella met with the teacher following the lesson to discuss how it went. Multiple teachers specifically stated their appreciation of how she created an opportunity for them to reflect on their practice. One teacher summarized her experience:

Siento que fue un éxito dado que son oportunidades donde el docente realice un papel tanto en teórico como práctico, excelente los videos y los materiales facilitados por el proyecto, la supervisión excelente dado ayuda, al mejor al docente.” [I feel the program was a success that gave us, the teacher, the opportunity to take on a role that is just as theoretical as practical, the videos and materials were excellent, the supervision was excellent and helpful, all to better the teacher].
(Contact Summary Transcript
12/14/2012)

This demonstrates how Bella's mentorship style afforded teachers skills to transfer theoretical and conceptual ideas into practice. In other words, she facilitated the teachers to take on a role “*tanto en teórico como práctico*” [just as theoretical as practical]. This achievement

was facilitated through the combination of valuing local teacher knowledge and engaging teachers in discussion of their teaching practices.

Innovation and Development in Teaching Practices

Pedagogical Knowledge

Most teachers highly valued learning new instructional strategies and implemented collaborative learning activities practiced during the professional development training in the form of scaffolded lessons and interactive activities. For example, Laurita, a 6th grade teacher, creatively had her students take measurements of several ingredients to make *pinolillo*, a traditional Nicaraguan beverage, as a lesson on proportions. She then asked children to come up with their own definition of “proportion.” Afterwards, she had the students watch the Khan Academy video in which examples and explanations were given regarding proportions and measurements. Bella noted that students seemed unusually animated, and that this lesson departed dramatically from the typical pattern of rote memorization and individual problem-solving she had previously observed.

Leticia, a third grade teacher, used the videos to teach more advanced topics once she realized that her students had mastered multiplication (e.g. how to multiply three digit numbers and how to divide decimals). Another teacher, Yvette, used a 2-5 minute video clip on a daily basis, assigning her students exercises and the task of re-watching the math videos at home on their OLPC XO. She also created math centers, activities using decks of cards to enhance multiplication skills, and a classroom *pulperia* [corner store] from empty bottles, cans, and other market objects as relevant learning tools. Additionally, she discovered a math program on the OLPC XO called Tux Math that allows the students to practice the skills she taught. She began to regularly plan a video

lesson followed by practice with Tux Math. Yvette, identified by Bella as one of the strongest teachers, also collaborated with the other 3rd grade teacher in sharing her ideas and lesson plans for the content videos. Teachers attributed increased student engagement and increased student learning based on participation in the intervention. This included not only content from the videos, but also pedagogical strategies from their workshops and interactions with Bella.

Researchers also observed high student engagement during lessons implementing the videos and collaborative instructional strategies with a few exceptions. However, teacher’ classroom management was strongly related to the effective use of videos. For instance, at Savir, one teacher created systems in which the OLPC XO and videos were being used efficiently. She had all students play the video at the same time, whereas in other classrooms students did not play the videos on their computers at the same time, and consequently the audio was mismatched and loud, while students were off-task and distracted (Fieldnotes, 8/10/12). In this case, the teacher had organized routines and expectations around laptop care; most students brought their XO. She set the expectation that all kids bring their laptops already charged, holding them accountable. She modeled her own use and care of her laptop. In other classes with the OLPC XO, teachers reported that children did not always have a charged laptop, and so could not participate (Fieldnotes, 8/10/12).

In the cases of schools without the OLPC XO, teachers used a television paired with a DVD. This too reflected skill on the teacher’s part in organizing an effective learning environment. In one field observation, the researchers noted that as the Khan math video played one student sat in front blocking the screen for the first 15 seconds. It wasn’t until the teacher paused the video and moved the boy blocking the front row that other students were

able to see the teaching demonstration (Fieldnotes, 8/9/2012). In another classroom, a teacher was seen un-pausing the video and accidentally putting it on a different video (Fieldnotes, 8/8/2012). Both cases demonstrate the intervention depended on the teacher rather than the technology for success.

Teacher Collaboration

Innovative and creative teachers have forged supportive relationships with other teachers, both in the program and outside of the program. For example, Jecenia has given fellow teachers from different schools not participating in the intervention her Khan Academy DVD to copy. She also acted as a mentor to a 6th grade teacher, Miriam, another teacher participant, who had been struggling to move beyond teacher-centered instruction. Jecenia consistently shared lessons and ideas with Miriam.

Yvette also recounted that after the professional development, teachers were reflective and would regularly come together to ask one another “¿Cómo viste estas cosas, y que te parece, que hiciste, que empleaste?” [How did you see things, what did you think, what did you do, what have you implemented?] (Yvette interview, 8/2012). Other times they would meet with teachers who had not been involved in the educational intervention. She recounted the power of collaboration afforded by the intervention and professional development and mentioned how teachers from other schools would join them for meetings and would often voice wishing they were part of the intervention. To help these teachers, they would discuss the Khan project and share their materials, DVDs, and pedagogy. Yvette explained, “Por eso le llamamos “inter-capacitación” [That is why we called it “together-training”] (Yvette interview, 8/2012).

The co-construction of knowledge and sharing of resources builds their teaching communities. Together they supported one

another in growing both their individual teaching practice and that of their larger community. They identified the educational intervention as one of value and whose resources were worth sharing.

During one of the teacher trainings, seven teachers from another grade level, though not involved in the program, came to take part in the sharing of ideas. These teachers asked if the program could be expanded to include them (Yvette interview, 8/2012). This contributed to an understanding that interaction with others is essential in learning how to teach, as noted by Abrego, Rubin, & Sutterby (2006). At other schools, the teachers met to watch videos together and plan lessons. “*Están intercapacitándose entre ellas ... yo se que es un proyecto nuevo, pero van a haber resultados.*” [They are training one another ... I know this is a new project, but there will be results], shared an Alivah administrator (Cecilia Transcript, 8/2012). Teachers who were more advanced pedagogically shared their creative ideas with other teachers, while teachers with stronger content knowledge sought to support their peers.

5.2.3 Intervention Adaption

Videos have been used in multiple ways as content for teachers and students, family learning, and disseminating resources. In the case of the educational intervention teachers have used the videos in a variety of ways. Some examples include: a) teachers lending the DVD to other teachers not involved in the intervention; b) several schools expressing a desire to expand the program to other grades; c) parents watching the videos for their own knowledge and to help their children; and d) teachers watching videos for their own content knowledge or to learn different pedagogical methods. As shared by an Alivah administrator:

Lo que se está haciendo se adapta, si hay algo, toman la idea del video y lo que pueden hacer es adaptarlo a su realidad.

Si el video cumple con las expectativas del maestro entonces trabaja con el video, pero si solo hay algo nada más del video retoman lo que les servé.” [What is being done is adaptation. If there is anything they can take the idea of the video and what they can do is adapt it to their reality. Yes, if the video meets the expectations of the teacher then they work with the video, but if there are just a few things, they can take out what will serve them]. (Cecilia Transcript, 8/2012)

This administrator spoke to the ways she has seen the videos used towards local adaptation (“they can take out what will serve them”). She perceived teachers as agentive and creative in their use of videos, responding to the needs of their students and their own particular social, cultural and economic context. Similarly, another teacher recounted how she used and adapted the videos in response to her needs: *“Estaba viendo el tema de el día de mañana entonces yo tenia que ver primero el video para ver si se relacionaba, si era si pues perfecto hacerlo y si no hacerlo alguna innovaciones.”* [I would look at the theme for tomorrow so I would first have to watch the video to see if there was a relationship, if they were related then perfect to use and if not then I would make some innovative adjustments] (Yvette Transcript, 8/2012). This teacher not only used the educational intervention videos to adapt her math curriculum, but also found ways to use the video resources available from the Khan Academy to supplement other subject areas. She did not feel constrained by the educational intervention materials; rather, she saw the videos as tools at her disposal.

Furthermore, another teacher explained how the professional development trainings facilitated her growth.

Porque las matematicas todo el mundo le tiene miedo. En otras palabras,

para mi las matematicas son sencillas, pero he visto que uno puede ser creativo. Todos vemos lo malo de la matematica, solo ven los numeros y los numeros y los numeros, pero para mi me ha despertado la creatividad y ir mas alla. Estar en el proyecto es un gran logro para mi. El beneficio es mio, yo soy la que salgo con mi maleta llena. El proyecto ha venido lo primero a las escuelas que necesitan recursos. [This project, for me, has helped the Nicaraguan teacher because it has facilitated mathematics. I see it as facilitation because the whole world is afraid of math. In other words, for me math is easy, but I’ve seen that one can be more creative. We all see the negative in math, we only see numbers and numbers and more numbers, but for me it has awakened creativity and going beyond. Being in this project has been a great accomplishment for me. The benefit has been mine, I am the one that gets to leave with a full suitcase. The project has first come to schools that need resources]. (Jecenia Transcript, 8/2012)

Here, her final line (“I am the one that gets to leave with a full suitcase”) highlights her view of herself as possessing new skills and tools to deploy in the context of her school and students. Moreover she saw her experience as contributing despite serious structural, political and economic barriers to her professional growth, she expressed a sense of expertise, growth and agency. Agency implies interest and ownership of the outcomes; people who act with personal agency act with concern, interest, aim, purpose, intent and motivation (Holland, 1998). Jecenia and other teachers acted agentively and creatively here, drawing on all the resources available to them to improve educational outcomes in their community.

Implications and Scholarly Significance of this Study

Under the difficult conditions described above, numerous teachers prevailed and continued to show up and teach their students, while other teachers resisted through strikes and/or non-participation. While taking on additional work in the form of changing their pedagogical practices was unappealing for those who already felt taken advantage of by the school system, a select group of teachers identified some degree of change in their teaching practices as a result of the professional development and access to the videos. Looking at both teacher resistance and teacher engagement highlights the critical influence of individuals and communities. The content videos were not a panacea or easy fix for structural problems, but they did serve as an important tool in teachers' "battles".

We have much to learn from these teachers who were open and committed to improving their classroom instruction despite significant local challenges. Preliminary results indicate the potentially critical role teacher ideologies play in teacher responses to professional development and resulting pedagogical choices. For instance, the teachers making innovations and trying new things in their classrooms were open to feedback, attended voluntary trainings, felt a kinship with Bella, and sought to collaborate with others regarding their practice. These teachers also found the videos to be a resource from which they could pull and adapt as needed to their classroom context.

The teacher trainings have been opportunities to shift away from rote and reductionalist instructional transmission of knowledge towards collaborative sharing of multiple subjectivities in order to exchange "funds of knowledge" (L. C. Moll & Greenberg, 1990). Through fostering relationships of trust,

building rapport, coming to know teachers and their lived experiences, a deeper understanding and appreciation for the human experience can be gained which in turn has served as a powerful resource within the classroom (González, Moll, & Amanti, 2005).

The results of this study indicate that technology, no matter how innovative, does not by itself lead to widespread changes in teacher practice in rural primary schools. Not only is there a gap between teachers who are trained in the use of the technology from those who are untrained, but also an additional gap exists between teachers who embrace and those who resist technology specifically and in-service education generally. Major systemic changes in Nicaragua are needed in order to support teacher's motivation to change as well as their ability to change. Lastly, our findings suggest the critical role of building human capital. In the study described above, change in teacher's practices reflected not only access to technology, but time learning from each other and from Bella.

In this study, change occurred in isolated individuals and schools rather than the pilot program as a whole, suggesting that the social, economic and cultural context of individual schools and communities played a critical role in teacher learning. This indicates that further attempts to use technology to support education in Nicaragua and other developing nations should consider how to mitigate the effects of larger systemic barriers like salary freezes and strikes as well as address issues of access to resources (materials, technology, televisions, DVDs, etc.). Further iterations of the study will consider what made some teachers take up new methods and technologies despite the significant barriers to doing so. Moreover, research on professional learning communities indicates that learning in a collaborative, non-hierarchical context can reduce experienced teachers' resistance to change and innovations (van Dreil,

Verloop, & de Vos, 1998). Such professional development structures can also facilitate growth in teachers' confidence in the value of their own content and pedagogical content knowledge and increase their interest in trying out ideas from colleagues in their own classroom (Adams, 2000; Borko & Putnam, 1996). This suggests that the structure of the professional development should be modified to further increase teacher ownership of pedagogical innovations.

Training programs should include up-to-date pedagogical education methods and techniques linked to the curriculum in ways that are authentic and relevant to the teachers and students. Untrained teachers are on average younger than certified teachers; this provides an opportunity to develop policies to target these teachers, which are likely to remain in the system for a longer period of time (Angel-Urdinola & Laguna, 2008). Additionally, economic incentive programs aimed at keeping the best teachers within the educational system would help decrease attrition rates (Elvir et al., 2006). Reforms of the existing salary structure for teachers and then defining incentives according to education, training, experience, performance, specialization, and geographic location are also imperative.

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Appendix A

Interview Questions

1. Tell me a little bit about your school
2. Tell me a little bit about the training
3. How have you seen teachers include these ideas in their teaching and curriculum? How have you included these ideas in your teaching and curriculum?
4. What have you noticed about the participating schools/ teachers/ yourself prior to the training, during the training, after the training?
5. Why do you think the teachers volunteered for the training? Why did you volunteer for the training?
6. Tell me a little about yourself. Tell me a little about the other teachers you work with.
7. How would you describe the professional development training? (What did you see? What did you hear? What types of things did you do? How did you/the other teachers respond?)
8. How do you think the experience of taking part in the professional development training has influenced or not influenced the decisions you or other teachers make in the classroom since the training?
9. What are some of the constraints? How do the teachers navigate those constraints?

Appendix B

Code List

1. Professional development
2. Mentorship model
3. Student interaction
4. Teacher application of facilitator's suggestions
5. Effect of having observers in the classroom
6. Classroom attendance
7. Positioning/ Structure of desks
8. Engagement
9. Mentor intervention
10. Local adaptation
11. Brainstorming
12. Video use
13. Factors contributing or detracting to video use
14. Resources
15. Supplemental/ supportive technology
16. Home situations
17. Student personal needs (emotional needs)
18. Parental involvement
19. Professionalism
20. Teaching strategies
21. Issues with technology
22. Obstacles
23. Supportive structures
24. Change in practice
25. Assessment/ Performance
26. Novelty
27. Positive attitude
28. Positive experiences
29. Teacher motivation
30. Student learning
31. Teacher pedagogy