ABSTRACT

Title of dissertation: EXAMINING THE IMPACT OF TEACHER PRACTICE ON STUDENT LEARNING IN INTERACTIVE RADIO INSTRUCTION (IRI) CLASSROOMS: LESSONS FROM NEW DELHI AND RAJASTHAN (INDIA)

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This quantitative study examines the impact of teacher practices on student achievement in classrooms where the *English is Fun* Interactive Radio Instruction (IRI) programs were being used. A contemporary IRI design using a dual-audience approach, the *English is Fun* IRI programs delivered daily English language instruction to students in grades 1 and 2 in Delhi and Rajasthan through 120 30-minute programs via broadcast radio (the first audience) while modeling pedagogical techniques and behaviors for their teachers (the second audience). Few studies have examined how the dual-audience approach influences *student* learning. Using existing data from 32 teachers and 696 students, this study utilizes a multivariate multilevel model to examine the role of the primary expectations for teachers (e.g., setting up the IRI classroom, following instructions from the radio

characters and ensuring students are participating) and the role of secondary expectations for teachers (e.g., modeling pedagogies and facilitating learning beyond the instructions) in promoting students' learning in English listening skills, knowledge of vocabulary and use of sentences. The study finds that teacher practice on both sets of expectations mattered, but that practice in the secondary expectations mattered more. As expected, students made the smallest gains in the most difficult linguistic task (sentence use). The extent to which teachers satisfied the primary and secondary expectations was associated with gains in all three skills – confirming the relationship between students' English proficiency and teacher practice in a dual-audience program. When it came to gains in students' scores in sentence use, a teacher whose focus was greater on primary expectations had a negative effect on student performance in both states. In all, teacher practice clearly mattered but not in the same way for all three skills. An optimal scenario for teacher practice is presented in which gains in all three skills are maximized. These findings have important implications for the way the classroom teacher is cast in IRI programs that utilize a dual-audience approach and in the way IRI programs are contracted insofar as the role of the teacher in instruction is minimized and access is limited to instructional support from the IRI lessons alone.

EXAMINING THE IMPACT OF TEACHER PRACTICE ON STUDENT LEARNING IN INTERACTIVE RADIO INSTRUCTION (IRI) CLASSROOMS: LESSONS FROM NEW DELHI AND RAJASTHAN (INDIA)

by

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Preface

When I first began working at Education Development Center, I was trained in the IRI methodology. Over ten years, I helped develop scripts, plan implementation, measure student learning and report on outcomes. I spent countless hours poring over data to report to funders about the impact of IRI programs on student learning. The data only served an accountability purpose for validating funding.

Over time, I had the good fortune of encountering IRI in action in the field. I encountered children listening to the *Taonga Market* IRI program in a rural town in Zambia. They weren't in a classroom or in a building of any sort – they were sitting under a tree. And that's where they participated in the IRI lesson everyday – with their teacher. In Rajasthan, I encountered children in classes in the rear of the village market. In all these makeshift classrooms – as well as in schools that looked more traditional – complete with walls and chairs and desks – students and teachers listened to the IRI lessons, for the most part, captivated by the fantasy world presented in the stories. The experience of learning through song and games was often the first for teachers and students.

The data in this dissertation are a window to explore the pathways through which students in IRI classrooms *actually* learn. This dissertation has been an opportunity to do just that for children in 32 classrooms in Delhi and Rajasthan.

Dedication

To my father-in-law,

Ramesh Thukral,

Without whom I would never have learned the true purpose of my life.

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Most importantly, I want to thank my family who has endured much and supported more as I ventured through this dissertation. To my parents, Manu and Geeta Rami – thanks for believing in me, cooking many dinners so I could focus on writing, and

watching my kids so I could get this done. Your support and wisdom has been the raft that always carries me through any adventure or challenge. To my dearest husband, Sumit Thukral, who knows exactly what to say to get me through it all – with a smile. Your love, support, encouragement, cooking skills and sincere belief in my ability to finish have been immeasurable. To my little rascals – Kabir and Taara – when you're old enough to read this, I hope this dissertation encourages you to continue learning and to continue "making your imaginations bigger." Thank you for being my teachers in life – for your laughs when I was deep in writing, for your hugs when I was deep in analysis, and for your "I love you's" when I needed them most.

To my sister – Tejal Gambhir – who has, in my many journeys, been my number one cheerleader. Thank you for your healthy dose of skepticism to my many ideas (some of which are often crazy) but always supporting me despite my craziness. To my brother – Pathik – for being the real crazy one so that in contrast, I've managed to seem normal. To my soul family – Angie Wu, Aman Gambhir, Amit Thukral, Puja Thukral, Nisha Kapadia, Jimi Barot, Aarti Savani and the kids Rohan, Maya, Isha and Aryan – you've each put up with a lot and encouraged me more through this process – for that, I love you dearly. To my mother-in-law, Usha Thukral, thank you for all your support but most importantly, for not letting me forget papa's wishes that I finish this dissertation.

To my sisters-from-another-mister Dr. Mary Klyap and Dr. Pragati Godbole-Chaudhuri, you have been the peanut butter to my jelly, the ying to my yang. You have been my readers, my thought partners and my sanity. To my dear friends Dr. Maria Finger-Elam and Dr. Eva Yiu, thank you for your support and knowing, oftentimes more than me, that this day would come. I revel in the fact that these four ladies who have had the strongest effect on my learning and writing over the last year, are all themselves PhDs.

You've been there before, during and now have no choice but to stay with me after. See you on the other side, ladies. Finally, I want to thank my many classmates and colleagues who have provided words of encouragement and have set great examples for me to follow – Dr. Beth Douthirt-Cohen and Dr. Cara Jackson, in particular.

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Chapter 1: Introduction

This quantitative study examines the impact of teacher practices on student achievement in classrooms where Interactive Radio Instruction (IRI) programs were being used. Specifically, I examine the impact of teachers' practices while using the *English is Fun* IRI program with students in the early primary grades in two states in India – Delhi and Rajasthan.

In this chapter I introduce my study. First, I provide an overview about the use of IRIs in the United States (U.S.) and other countries and describe the problem that informs the study. Then, I discuss the use of IRI in India and the policy context that supports its use as an instructional technology. Next, I identify what I consider to be key gaps in the literature, which I believe this study will advance. Finally, I provide an overview of the study, specify my research questions, and discuss the study's potential contributions to the literature.

Problem Statement

Radio has widely been used for educational purposes, both in the U.S. (Tyler, 1944; Land, 1967) and in developing countries (Bosch, 1997; Corrales, 1995; Dock & Helwig, 1999; Leigh, 1995; Tilson, Jamison, Fryer, Godoy-Kain, & Imhoof, 1991). One specific incarnation of radio for educational purposes, Interactive Radio Instruction, or IRI, is a program delivered via broadcast radio into classrooms that utilizes an instructional design with an "interactive," conversational style to elicit responses (often 100 in a half-hour lesson) from the students as they listen to and interact with radio characters (Anzalone,

1987). Because IRI designs were developed for use in developing countries and particularly to "counteract low levels of teacher training and poor resources, the methodology relies heavily on the radio teacher to deliver instructional content" (Bosch, 2001, p. 45). In turn, the question about what role the classroom teacher should play during lessons has been addressed differently in various IRI series (Bosch & Crespo, 1995; De Fossard & Bosch, 1996). Earlier IRI series, especially designs that promoted mathematics instruction, tended to relegate teachers to a classroom management role, with the primary intention to expand student's access to educational content in developing countries (Friend, 1985). In these earlier designs, the low levels of teacher instructional abilities excluded them from much participation in instruction. More contemporary IRI designs, including designs that promote language acquisition, engender a more involved role for the teacher by delivering instruction to one audience (students) while providing in-class, in-service training to another audience (teachers) (Bosch, 1996). In these later designs, teachers' were exposed to techniques and behaviors to improve their instructional skills and presumably were able to play a more involved role in the classroom by facilitating through extensions of instruction during the lesson.

Building the teacher's capacity *while* delivering instruction to students was known as the dual-audience approach (De Fossard & Bosch, 1995). For students, radio characters in the IRI program, particularly a radio teacher, deliver instruction to students in the subject for which the programs have been developed. For teachers, the radio teacher (and other characters in the radio story), demonstrate pedagogical techniques and behaviors that the teacher can use in the classroom during the IRI lesson and even after the lesson has been completed.

In India, IRI programs were used to deliver English language instruction daily to students in grades 1-5 across nine states from 2003 through 2011 as part of a donor-funded project called Technology Tools for Teaching and Training (T4). The intervention continues today and is sustained by the Government of India (GOI). The *English is Fun* IRI program used a dual-audience approach to deliver English language instruction to students while modeling pedagogical techniques and behaviors for teachers. Although the *English is Fun* IRI program leverages the dual audience approach, the role of the teacher is explicitly limited to that of facilitating through lesson management, even though teachers are exposed to techniques and behaviors in support of their ability to play a more involved instructional role. Using T4's research data from 32 teachers and 696 students in two partner states in India, this study utilizes a multivariate multilevel model to examine the impact of IRI teachers' practice on their students' English proficiency skills. This study explores the role of two teacher practices – those explicitly required by the IRI program to facilitate student learning through lesson and classroom management alone and those implicitly promoted by the IRI's dual-audience design to facilitate student learning through extensions of instruction during the lesson – in promoting the acquisition of English-language skills.

Although the dual-audience design for IRIs is increasingly common, there is a paucity of research on how this approach actually influences *student* learning. A number of studies have examined the extent to which a dual-audience design encourages teachers to adopt desirable forms of pedagogy (Evans & Pier, 2008; Ho & Thukral, 2009), but few studies have examined the influence of these adopted practices on student learning. In other words, what are the effects of teachers' adoption of the pedagogical approaches promoted by the dual design compared to the effects when teachers simply facilitate through lesson management? This question echoes the underlying issue in research of the

use of advanced Information Communication Technologies (ICTs) in classrooms such as radio or computers – that a successful ICT classroom necessarily balances teacher involvement in instruction with delivery of content (Toyama, 2015).

Using a multivariate multilevel model, I examine how two sets of teacher practices – one associated with classroom or lesson management, the other associated with a more active role in instruction – influences students' gains in language proficiency. In essence, I examine what is the optimal balance for teacher involvement in instruction and delivery of content for a specific application of ICT in an international context – an IRI program for learning English in India.

More specifically, this study seeks to examine whether the programmatic assumption behind the *English is Fun* IRI program, that the primary role for the classroom teacher in delivering the IRI lesson is to manage students during the lesson, yielded the greatest impact on student learning or if there is an equal – or greater – impact of teachers' secondary role on student learning outcomes. I examine the role of the primary expectations for teachers (e.g., setting up the IRI classroom, following instructions from the radio characters and ensuring students are participating) and the role of secondary expectations for teachers (e.g., modeling pedagogies and facilitating learning beyond the instructions) in promoting students' learning. When teachers fulfilled these secondary expectations, were they *able* to do more to facilitate learning in the *English is Fun* IRI program? And when they did go beyond these basic expectations, did students fare better or worse in English language proficiency?

IRI in India

Beginning in 2004, the Government of India partnered with the United States Agency for International Development (USAID) to support the implementation of the

Technology Tools for Teaching and Training (T4) project, implemented by the Education Development Center. From 2004 until 2010 when the project ended, the flagship program of the T4 project was the Interactive Radio Instruction (IRI) program, with a variety of series for teaching English, mathematics, science, and social studies to students in the primary grades in nine partner states. In six of these states, students in the primary grades listened to the *English is Fun* IRI series, which spanned a full academic year, with 30-minute lessons implemented on a daily basis.[1]

The *English is Fun* IRI series was targeted at improving student's English proficiency in six states in alignment with national education policies (EDC, 2004). First, the mandate to teach English beginning in first grade took effect across India as part of the "Education for All" initiative *Sarva Shiksha Abhiyan (SSA)*. Under this initiative, the opportunity to use information and communication technologies (ICTs) in schools also expanded with the National Policy for ICTs in School Education (NPISE) (MHRD, 2009). NPISE was a federal policy that set the stage for how each of the 28 individual states plus seven territories[2] invested and implemented ICTs in schools. Released in 2009 by the Government of India, the policy was developed through a series of consultations with public and private partners, including developers of ICTs, funding agencies, and state and local level education officials. The policy promoted three general goals for technology in education –to improve the quality of education, to prepare students to enter the workforce, and to ensure that students obtain a working knowledge of technology (Pandey, 2010).

[1] The *English is Fun* IRI series was implemented with students in Grades 1 and 2 in Delhi and with students in Grades 1 to 4 in Rajasthan.

[2] The 28 states officially reported do not include the contested area of Jammu and Kashmir. Territories include: the National Capital Territory of New Delhi, Andaman and Nicobar Islands, Chandigarh, Dadra and Nagar Haveli, Daman and Diu, Lakshadweep and Puducherry.

Between 2004 (when the T4 project began) and 2009 (when the NPISE was released), the IRI series *English is Fun* was developed, piloted and implemented in Chhattisgarh, Jharkhand, Bihar, Madhya Pradesh, Rajasthan and Delhi. During the course of the IRI program's development, the stated goals of the IRI series were to a) deliver English language instruction to students in the early primary grades and b) have limited reliance on classroom teachers to deliver English instruction (EDC, 2006). The first mandate was based on the national policy to begin English language instruction in the primary grades; the second mandate was based on the government's own assessment of teachers' English content knowledge and the T4 project's audience research that described teachers' English and pedagogical skills as "poor" (EDC, 2004). Based on discussions with project staff, EDC and USAID attempted to align the IRI programs with the NPISE, other policies that state and national leaders were developing at that time, and the individual states in which they were negotiating the piloting and implementation of the programs (H. Thukral, personal communication, October 10, 2010).

As a result of the project's mandate and the political environment, the *English is Fun* IRI series had a single, primary goal: to serve students in the early primary grades by providing a full course of instruction in English language. The classroom teacher – who was assumed to generally have a poor level of pedagogical and content knowledge in the teaching of English – was included in delivering this primary goal, but as a member of the 'teaching team' (EDC, 2006; Friend, 1985). The teaching team included the classroom teacher and the radio teacher, and each had a specific set of responsibilities. As a member of the teaching team, the classroom teacher, with minimal training, was expected to provide classroom and lesson management support (making sure the radio was turned on, all students were participating, and the directions given to students were followed) while the radio teacher delivered English language instruction to students. In other words, in

keeping with the dual-audience approach of IRI and to align the *English is Fun* IRI series with national policies and state expectations, the classroom teacher would have a modest role in delivering English instruction to students, one that did not necessitate the teacher to have rich pedagogical and content knowledge in delivering English language instruction (EDC, 2006).

The dual-audience approach, upon which the *English is Fun* IRI programs was based, directly addressed the supposedly poor pedagogical and content knowledge among classroom teachers in developing countries (Bosch, 1997; EDC, 2006). The IRI design aimed to provide teachers with in-service training while also creating an expectation, albeit implicit, that teachers could adopt a more active role in the IRI classroom. The dual-audience approach was described as follows: "While listening to the radio, learners actively participate in the lesson by singing, reading, writing, answering questions and solving problems; the classroom teacher is led through activities with the intention to model student-centered pedagogical techniques which the teacher is then expected to continue after the end of the radio lesson in the IRI subject and other content areas as well" (p. 48, de Fossard & Bosch, 1996). This approach became a hallmark of the IRI methodology as it was an attempt to directly address teachers' poor pedagogical skills but without relying on these skills during the IRI lessons to provide instruction to students (Bosch, 1997). This dual-audience feature may have been one reason why IRI programs became a popular intervention for USAID in developing contexts; but the examination of the influence of the dual-audience approach falls short. Specifically, avoiding reliance on the teachers' improving pedagogical skills during the IRI lesson meant that the ultimate effects of the dual-audience approach on student learning outcomes have largely remained unexamined.

The two goals of the *English is Fun* IRI program – to provide English instruction to students and to provide in-service training for teachers – are important to differentiate here, because the distinction is critical to this analysis. The primary goal of the *English is Fun* IRI series was determined by the overall mandate of the IRI programs in each partner state; towards this goal, the role of the teacher was minimal, with little expectations in terms of direct instruction to students. The secondary goal was driven by the IRI design itself – specifically, that as the second audience of the dual-audience approach, teachers would improve their pedagogical and content knowledge by way of participating in the IRI lesson on a daily basis. Without any face-to-face support for this second goal (in contrast to a five-day training teachers received for their role under the primary goal), this goal, for the most part, was implicit to the design of the IRI lessons themselves. This secondary goal was not directly stated, either in the design documents reviewed or in the project's contractual documents (EDC, 2004; EDC, 2006). Furthermore, the dual-audience approach of the IRI design expects that the classroom teacher would continue the pedagogical techniques after the IRI lesson or that they would be evidenced during their instruction in other classes (Royer, 2006). The value of the teachers' improving pedagogical skills to the IRI lesson itself however is the focus of this study, specifically examining the influence of two sets of teacher practices on student learning *during* the IRI lesson.

The only evidence that supports this secondary goal, and the basis on which I identify it as a secondary goal, include a) that the project collected data on the extent to which this secondary goal was being achieved in classrooms; and b) that the IRI methodology, on which the *English is Fun* IRI series was based, calls for the provision of pedagogical and content support to teachers. Therefore, for the purposes of this analysis, I identify the way in which the IRI programs worked to improve teachers' pedagogical and

content knowledge as a secondary goal of the *English is Fun* IRI program. This underlying assumption of my study is based on my analysis of program documentation and the project's actual implementation.

As a secondary goal, any improvements in teachers' English language instruction during the IRI lesson were a by-product of their participation in the IRI lessons. Teachers were not provided with any face-to-face training aimed at improving their pedagogical and content knowledge, nor were they formally made aware of the modeling of pedagogical techniques and behaviors that were embedded in the IRI programs. Throughout the IRI series, the classroom teachers were explicitly told to focus on their role in setting up the IRI classroom and ensuring the IRI lesson occurred on a daily basis (i.e., making sure students participated, setting up the IRI classroom, and following directions when they were directed to the teacher). Put differently, the secondary goal was executed implicitly in the design of the IRI lessons; the primary goal was executed explicitly in the project's mandate, the training provided to teachers, and in the formal expectations for classroom teachers.

Thus far, I have examined the conceptualization of the teacher's role from the perspective of the T4 project. I now turn to examining the role of the teacher from the perspective of the broader literature on Information and Communication Technologies – or ICTs – within which Interactive Radio Instruction falls. I use this literature to situate IRI's dual-audience approach.

Literature on the use of ICTs in classrooms extensively documents the critical role of the classroom teacher, particularly in the effective use of the ICT with students. While the availability of technology in the classroom does not guarantee a positive impact on student outcomes (Dynarski, Heaviside, Novak, Carey, Campuzano, Means, Murphy,

Penuel, Javitz, Emery, & Sussex, 2007; Taber, 2010; Wenglinsky, 1998), the way in which the teacher uses the technology can help to improve students' performance on achievement tests and related educational outcomes (Buendia, 2002; Chao-Hsiu, 2008; Chung, 2002; Judson, 2010; Trotter, 1997; Warschauer & Matuchniak, 2010; Wainer, 2008; Wenglinsky, 2006; Wheeler, 2001). From this perspective, the role of the teacher with technology is intricately tied to student outcomes.

How *does* the teacher factor into the ICT classroom though? I draw from two specific bodies of ICT literature because they provide a context in which to understand the explicit and implicit goals of the *English is Fun* IRI series. On the one hand, the radio-based programs are implemented as a dissemination technology that delivers English content to students; on the other hand, it is designed as an instructional technology that implicitly expects the teacher to play an instructional role in the classroom. The dual-audience approach aims to build teachers' pedagogical skills so that they may fulfill this expectation. At the intersection of these two bodies of literature is where I situate this study.

The purpose of this study was to examine to what extent the IRI methodology, and particularly, the *English is Fun* IRI series in Delhi and Rajasthan, was effective in isolating the task of teaching English to students to the radio teacher. In other words, how blurred was the line between classroom teacher and radio teacher, particularly when it came to delivering instruction to students during the *English is Fun* IRI lesson? Did the radio teacher, in fact, primarily carry the instructional burden throughout the 120-lesson series? The focus of my study was to examine to what extent the classroom teachers 'participation in classroom management as a member of the 'teaching team' – the primary expectations – affected student English proficiency and the extent to which teachers'

engagement in delivering instruction – the secondary expectations – affected student outcomes. Was the teacher's practice in the secondary expectations, in fact, an added benefit of the IRI series or a necessary element in improving student outcomes?

The Policy Context in India

In the U.S., development of and support for computer-based learning thrives today with a high investment of resources for training, maintenance, and development (Dynarski et al., 2007). In India, poor infrastructure and scarce school-level resources deem such an intervention, at scale, largely unfeasible.[3] Instead, the policy context in India supports alternative, low-cost, low-resource ICTs such as radio. In the following section, I examine the policy context that contributed to the expansion of one particular ICT – radio – for the teaching of English to students in primary grades. In this policy context, I explore the factors surrounding the implementation of IRI in India as part of the T4 project, from which the data of interest for this study are drawn.

To understand the context in which the IRI programs were launched, and subsequently their impact, I first examine the policy context. The National Policy for ICTs in School Education (NPISE) is a federal policy that sets the stage for how each of the 28 individual states plus seven territories[4] invests and implements ICTs in schools. Released in 2009 by the Government of India, the policy was developed through a series of consultations with public and private partners, including developers of ICTs, funding agencies, and state and local level education officials. The policy promotes three general goals for technology in education – a) to improve the quality of education, b) to prepare

[3] Although the Azim Premji Foundation has had success in implementing computer-based interventions in schools across India, it has been at a modest scale in each state.
[4] The 28 states officially reported do not include the contested area of Jammu and Kashmir. Territories include: the National Capital Territory of New Delhi, Andaman and Nicobar Islands, Chandigarh, Dadra and Nagar Haveli, Daman and Diu, Lakshadweep and Puducherry.

students to enter the workforce, and c) to ensure that students obtain a working knowledge of technology (MHRD, 2009). Despite these stated goals, the NPISE is most influenced by the Government of India's flagship program to achieve Universal Primary Education, known in Hindi as *Sarva Shiksha Abhiyan* (SSA), which translates to "Education for All".

In response to the global Education for All (EFA) movement, the government of India formalized its commitment to universal access through the SSA program, which manifested itself in the form of SSA missions in each State. Partly a response to the global movement and partly a response to the nature of education indicators (such as those used by the United Nations to gauge and compare education quality across countries), the goal of SSA is to reduce the number of out-of-school students, increase the number of schools, and achieve 100% enrollment of school-aged children (Pandey, 2011).

As such, an overarching yet implicit goal of the NPISE is to achieve universal primary education; NPISE interprets the three explicitly stated goals of improving quality, access, and efficiency within the context of universalizing education (NCERT, 2005a; Pandey, 2010). In terms of the types of ICTs that states should invest in to realize the goals, the policy makes no clear recommendations; it promotes a range of ICTs – "from projecting media, to multimedia self-learning modules, to simulations to virtual learning environments" (MHRD, 2009, p.5). However, the ICTs of choice become clearer in the funding mechanism for the policy.

The funding mechanism for the NPISE policy is the Government of India's Eleventh Five Year Plan, in which funding for the policy is again tied closely to the goal of universal primary education but with two very specific indicators – enrollment and the number of out-of-school children who should be attending school. As a result of these various mechanisms, the NPISE is essentially a policy lever to universalize education by

providing all students with access to basic instruction; with the primary indicators being total enrollment (targeted at 100%) and reducing the number of out-of-school children (to zero). Within this policy context, the policy window for promoting an intervention that utilized radio – an easily accessible ICT – and one that can deliver content to out-of-school children – was wide open.

As a result of this policy context and the early results of IRI observed in the State of Chhattisgarh, discussions between EDC, USAID and the Governments of several Indian States (including Rajasthan and New Delhi) dovetailed into utilizing radio as the primary delivery mechanism for English instruction under the T4 project. Even though the project featured programing using other technologies (such as computer-based instruction for Science in Karnataka), the appeal of radio was its low cost (the upfront cost of the radio would be borne by the project and USAID, with little to no maintenance required) and IRI's ability to simultaneously address teachers' poor content and teaching skills while delivering a full course of English instruction to students in classrooms.

In a developing country like India, the burden on any ICT, whether cutting-edge or not, is arguably heavier than it would be in a developed country (Pandey, 2011). Although the modern research literature on ICTs in education rarely even includes radio for classroom learning (Ross, Morrison and Lowther, 2010; Tomei, 2009), this large-scale approach for direct classroom instruction was attractive to India's policymakers in the policy window created by NPISE and the Eleventh Year Plan. It aligned well with the broader goals set forth by the NPISE and operated within the constraints of an under-prepared teaching workforce with limited classroom resources. Under these constraints ICT options were limited. More advanced, cutting-edge technologies, even those offered and used in samples of schools by the T4 project, were not politically supported, and, in

reality posed substantial logistical and administrative problems (Jha and Parvati, 2009; Kasinathan, 2008). The greatest challenge to using an advanced technology like computers over a commonplace technology like radio was the cost of maintenance – an aspect often left unaddressed when technology advocates talk about the possibilities presented by computers to improve learning (Toyama, 2015). Insightfully, the cost of maintenance was a considerable challenge given the desire by government officials in Delhi and Rajasthan to implement the program state-wide (EDC, 2009). The appeal of IRI's ability to expand access to English language instruction for all students using a low-cost technology *and* minimally relying on classroom teachers was undeniably a part of the broad support that IRIs received across six States in India.

Gaps and Need for Study

Between the early 1970's and the late 1990's, evaluations of IRI pilot projects were primarily focused on determining the impact of the program on student outcomes when compared with control classrooms not using IRI (Bosch, 1997; Corrales, 1995; Dock & Helwig, 1999; Leigh, 1995; Tilson et al., 1991). For example, a study by Searle, Suppes and Friend (1978) of a Mathematics IRI pilot in Nicaragua examined student test scores to determine whether the IRI lesson had led to gains in student achievement. Published in a technical report by Stanford University and later in a book by the authors, the study found that students in IRI classrooms made significant gains compared to their non-IRI peers (ibid). These early IRI studies were primarily concerned with establishing a policy space, or empirical justification, for radio as a viable medium of instruction (termed 'media studies' by Cuban, 2001). As Jamison, Suppes and Wells (1974) argued, after reviewing education research on the effectiveness on instructional radio in the U.S. and developing countries, "instructional radio (supplemented with appropriate printed

material) can be used to teach most subjects as effectively as a live classroom instructor or instructional television" (p. 67).

Today, the majority of literature and research available on IRI still comes from project evaluations and reports, which typically examine only the effectiveness of individual programs through a comparison of student outcomes with and without IRI and not the effects of the dual-audience approach *on* learning. Ho and Thukral (2009) reviewed 37 IRI projects conducted by EDC between 1975 and 2010. According to Ho and Thukral (2009), most of the IRI evaluations included experimental-control designs that established impact on student learning using a comparison of mean pre-test and post-test scores with some descriptive analysis. Few evaluations investigated outcomes for teachers – even when a dual-audience approach was being used, but those that did relied primarily on single-case designs where teachers were compared to their own prior observation scores. Across the IRI evaluations, none utilized a multivariate, multilevel model of teacher and student variables to control for differences between groups in student characteristics or to examine whether the designated role of the classroom teacher during the IRI lesson was appropriate, particularly when the teacher's role was also influenced by the IRI program. In other words, no study has examined the effects of the dual-audience approach on student learning outcomes.

The evaluation of the *English is Fun* IRI program in India, which used the same data used in this study, examined results for teachers separately from results for student. The only examination of the influence of teacher practice *on* student outcomes was done at the item level, comparing the average student gain scores in classrooms where teachers demonstrated the desired behavior *often* to the average student gain scores in classrooms where teachers demonstrated the behaviors *infrequently*. Like the research on IRI programs in general, the research on *English is Fun*, especially as an example of a dual-

audience design, is under developed. Prior research has not examined the possible role of the dual-audience design on student learning or subjected the data to more rigorous forms of statistical analyses. Did students benefit from teachers taking a more active role in instruction during the IRI lesson, even though the primary expectations for the teachers' during the lesson was classroom or lesson management? I provide an overview of the data I use to explore this question next.

Overview of the Study

Using existing data on IRI from classrooms in Delhi and Rajasthan, the proposed study seeks to examine whether there is a relationship between teacher practice and student achievement in English proficiency in IRI classrooms in Delhi and Rajasthan, including whether the relationship between the primary expectations *or* the secondary expectations for teacher practices had a greater influence on student outcomes.

The study builds upon evaluation results from India's T4 project. The project collected data for teachers and students in Delhi and Rajasthan who participated in the IRI intervention in 2009-2010. Figure 1 below shows the data available from the T4 project in 2009-2010, when student and teacher data were both collected. The project conducted teacher observations and assessed students' English speaking and comprehension skills in randomly selected classrooms from those participating in the IRI intervention in Delhi and Rajasthan. In classrooms that did not participate in the intervention (i.e. non-IRI) but did receive the routine English instruction they would have received from their teacher – noted as 'traditional instruction only' in Figure 1.1 – only student data were collected.

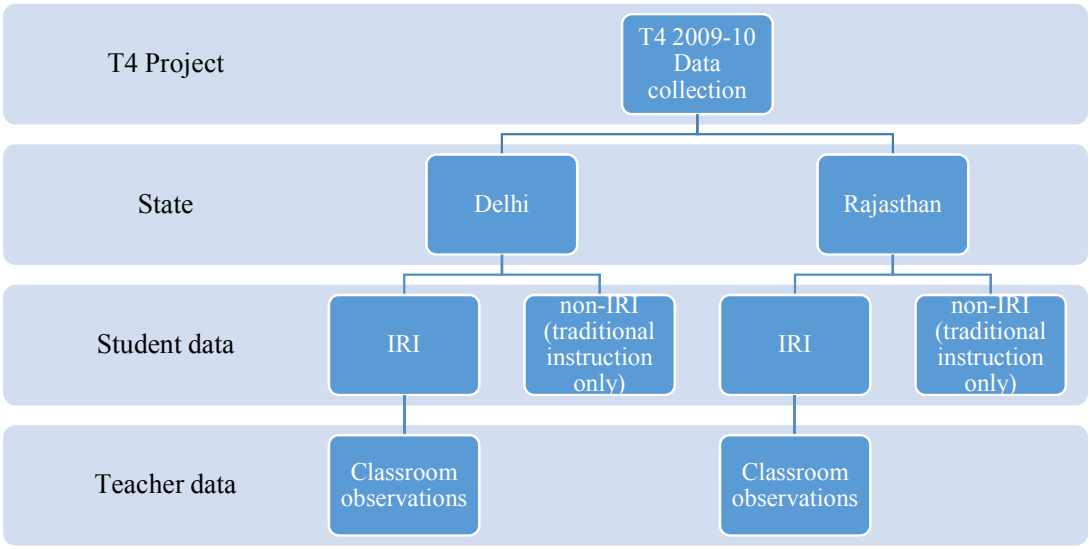


Figure 1.1 IRI Teacher and Student Data Collected

My study uses data from 32 teachers (or classrooms) and 696 students in grades 1 and 2 who participated in the IRI program during the 2009-2010 academic year. During that time students and teachers listened to approximately 120 interactive radio lessons, with each lesson lasting approximately 30 minutes. Students completed English language assessments just prior to the implementation of the IRI program and towards the end of the academic year. The assessments gauged students listening skills, knowledge of vocabulary, and use of sentences. Observers, trained by the IRI designers, observed between 2 and 6 lessons per teacher during the second half of the series, recording teachers' use of 14 different teacher practices during the lesson.

Analytic Focus and Questions

Since students in the study are nested within teachers the research questions are multilevel.[5] Because students were tested for English language proficiency in multiple

[5] Teachers and classrooms are used interchangeably in this study because the teachers in the selected classrooms only taught one IRI class.

skill areas, the outcomes of interest are multivariate (e.g., listening skills, vocabulary knowledge, and sentence use). The analytic method I use to answer these questions is multivariate, multilevel modeling (Raudenbush & Bryk, 2002). The dataset, while limited because of its secondary nature, provides ample opportunity to explore how the in-service training embedded in the dual-audience design influenced student learning. As of spring 2013, the dataset has only been used to report to the funding agency (USAID) on the learning gains of IRI students versus non-IRI students, and separately on the observed changes in IRI teachers' practices using simple, mostly bivariate analytic models. This study used multivariate, multilevel modeling to examine the following research questions:

1. How do student English proficiency gains in listening, vocabulary and sentence use vary significantly between classrooms/teachers who participated in the intervention?
2. How are student English proficiency gains in listening, vocabulary and sentence use influenced by teacher practices, and, if so, which types of practices matter most?

The first question estimates the fully unconditional model and measures whether achievement outcomes vary between teachers (or classrooms, given the 1:1 relationship in the dataset). The second research question measures whether there is a relationship between the independent variables of interest (the extent to which the observed teacher practice satisfies the primary expectations and secondary expectations) and the outcome variables (English proficiency as measured by tests for English listening, vocabulary knowledge and sentence speaking) controlling for the number of classroom observations, State, and individual-level differences between classes (e.g., student gender, caste, and father's highest level of education).

Significance of the Study

This study contributes to the research literature on IRI by examining the dual-audience design, expectations of the classroom teacher practices during the IRI lesson, and the influence of those practices on students' proficiency in English. This study contributes to the ways in which projects of this type are implemented, particularly the ways in which the role of the classroom teacher is envisioned and possibly supported. This study also contributes methodologically to IRI research, because most of what is known of the impact of IRI in India (and for the most part, across the globe) comes from simple evaluation studies conducted by implementing partners. These evaluations are limited in scope since they are intended to respond only to project objectives and use simple correlations to determine relationships between teacher- and student-level variables. Because I used multivariate, multilevel modeling in the study, I was able to explore a broader range of research questions with greater confidence in the internal validity of the results.

More broadly, this study is useful in expanding our understanding of prevalent education technology in developing countries. Specifically, as the literature on the role of teachers using cutting-edge technologies continues to grow in developed countries and to a lesser extent in developing countries (Ericsson, 2013; World Bank, 2015; UNESCO Institute for Statistics, 2015), the teacher's ICT and pedagogical skills and knowledge are consistently mentioned as an important consideration for success.[6] By examining a simple, low-cost ICT intervention that has been used at scale in India, this study extends

[6] The World Bank Education and Technology blog, moderated by Senior Education & Technology Policy Specialist and Global Lead for Innovation in Education Michael Trucano, reviews many of the cutting-edge technologies funded by the World Bank in developing countries – including video games for early childhood programs, tablets in primary grades, and the use of internet to connect middle and high school students and teachers around the globe (blogs.worldbank.org). However, these efforts are largely pilot or implemented in a few schools or districts, and not at the scale of use of IRI.

the literature about IRI as a technology that occupies an important place in the educational landscape of developing countries, particularly as a tool for expanding access to instruction for large populations of children. This study helps to fulfill the need for continued scholarship that tests and checks our assumptions about IRI interventions and specifically the impact of the dual-audience approach on student learning, *especially in contexts where student learning and teacher skills are both critically low*.

Research Interest

My interest in pursuing this research topic stems from my prior work. When I first began working at Education Development Center, I was trained in the IRI methodology. Over ten years, I helped develop scripts, plan implementation, measure student learning and report on outcomes. I also worked in developing the programs that would ultimately be the *English is Fun* IRI series that was implemented in Delhi and Rajasthan. While I was involved in the collection of the data at that time, it was primarily for the purpose of reporting annually to the funding agency. I had not conceptualized my dissertation topic at the time.

My motivation for studying this topic however did begin while I was still working on these data as an employee at the Education Development Center. With an intervention that, by 2010, was being used to reach over 35 million students in Grades 1 through 7 in various subject matter, I was keenly interested in understanding *how* the IRI intervention affected students' learning, not just that it did. Furthermore, as a low-cost technology that had already seen its prime in developed countries, radio seemed to be delivering consistently and at low cost in developing contexts. Why and how, I was curious to really find out. What the studies conducted by EDC told me was that students made gains; what

I really wanted to know was *how* – was it the program alone or was there much more that the teacher was doing than we were preparing them for?

Chapter 2: Literature Review

In this chapter I review the research on interactive radio instruction (IRI) and describe IRI interventions, including the *English is Fun* IRI that is the focus of this study. While there is limited research on IRI programs, as discussed in the previous chapter, I review the research that exists and the critiques of that research. I also describe fundamental components of IRI, the evolution of the IRI approach over time, and particularly the design of the *English is Fun* IRI program in greater detail.

Overview of IRI

Interactive Radio Instruction (IRI) is an education intervention used in developing countries that combines an audio medium – usually broadcast radio – with an active learning pedagogy intended to improve educational quality (Anzalone & Bosch, 2005). IRI lessons are 'scripted conversations' between the radio characters and the listening students, where students respond during timed pauses built into activities, games, and exercises. The programs are approximately thirty minutes in length and are usually used every day, for a total of 100 to 150 lessons per grade.

The original model of IRI was used to teach mathematics to students in grades 1 and 2 in Nicaragua. The Nicaragua IRI series was developed by a team from Stanford University in the early 1970s and was funded as a project by the U.S. Agency for International Development (USAID). Since then, IRI has been used to teach a variety of subjects in over 80 countries. Generally, the guiding principles of projects that utilize IRI as an intervention include:

1. Close correspondence between the intervention and the official curriculum.
2. Complete coverage of the curriculum.

3. Classroom teachers must find the lessons easy to use.
4. Wide scale implementation must be possible, the cost low, and logistics relatively easy.

The primary agency that has developed and implemented IRI projects globally is Education Development Center (EDC), which is the source for the dataset that I use in this study and the project in which I participated while working at EDC.

IRI Research

Between the early 1970's and the late 1990's, this particular application of radio for educational purposes dominated the research on radio in education in developing countries (in the U.S., computers were the Information and Communications Technology, or ICT, of choice). Research on IRI, both then and now, has been largely limited to agencies and groups with a vested interest in the projects using IRI; and present a limitation to the quality of IRI research and critiques available in the literature.

In the nascent stages of IRI's development, researchers at Stanford University conducted studies of pilot projects using IRI in Nicaragua. These studies reported significant learning gains and cost-effective ratios for students participating in the IRI intervention compared to students receiving traditional instruction (i.e., instruction in the target subject by the teacher without the presence of the IRI lessons) (Bosch, 1997; Corrales, 1995; Dock and Helwig, 1999; Leigh, 1995; Moulton, 1994; Tilson, T., Jamison, D.T., Fryer, M., Godoy-Kain, P., Imhoof, M., 1991). Critics, however, noted that both learning gains and cost-effectiveness ratios may have been inflated due to a variety of assumptions in determining the gains and costs, including cost of expansion, overhead cost distribution, and choice of comparison groups; and the reliance on evaluations of effectiveness used to pilot projects. Critics also questioned the sustainability of IRI

projects beyond the first few years of their piloting, often primarily funded by an international agency for a limited period of time (Klees, 1994). Moreover, in terms of the evaluation of student learning gains, limited information was available in the studies themselves regarding the development of tools, the level of in-class support received by IRI teachers (by project staff, observers and Ministry staff interested in the interventions success) or the quantity and quality of instruction in non-IRI schools. In the absence of these details, the true impact of IRI on student learning gains may be over-stated in these studies.

In terms of the research questions asked by these studies, Searle, Suppes and Friend's (1978) study of a mathematics IRI pilot in Nicaragua examined weekly teacher observations and student test scores to determine whether the IRI lesson had led to gains in student achievement (published in a technical report by Stanford University and later in a book by the authors). Comparing student test score gains under traditional instruction to gains when they were taught using the IRI mathematics lessons, the authors found that students had a 10 percentage point increase in mathematics learning under traditional methods and a 30 percentage point increase in mathematics learning with IRI (Searle, et al, 1975). A comparison of IRI and non-IRI language learners from a follow-on language instruction project also in Nicaragua showed that IRI learners made a gain of 34 percentage points from pre-test to post-test while non-IRI learners gained 12 percentage points (Searle, et al, 1978).

What is common across these early studies is their focus on establishing the impact of the medium (radio) versus traditional instruction. These types of studies are often termed 'media studies', because they compare the effectiveness of different media in promoting some desirable outcome, such as learning in a particular subject area (Cuban, 2001). Although these studies rightfully addressed the questions of their time, the IRI

research agenda has not progressed. Today, the majority of literature available on IRI comes from project evaluation results that focus almost exclusively on program impact in accordance with project mandates from funding organizations; as such, very few projects are expected to examine differences in impact regarding design, teacher roles, or context. The results of existing evaluations of IRI programs are discussed next.

Evaluations of IRI Projects

Evaluations of the impact of IRI on student outcomes have been conducted by the implementing partner (EDC), external consultants, and in the early 1980s and 1990s, by a limited number of research institutions implementing IRI programs. Generally, the evaluations were used to justify IRI as a medium of instruction. In an attempt to cull together results across countries, content, and grade levels, I conducted a review of research for the primary implementing agency for IRI (EDC) and reported findings from the evaluation of 37 IRI programs between 1975 and 2010 (Ho and Thukral, 2009). The analysis sought to summarize the magnitude of impact on student learning using effect sizes; additionally, two cases where IRI programs focused on teacher professional development (instead of students) examined the impact of IRI on teacher practice. Although this secondary analysis revealed trends across time, countries and IRI models, it did not control for differences in implementation models (level of teacher support, frequency of IRI lessons, teacher training, or the possible effects of data collection approaches (such as classroom observers providing hands-on support to teachers in the beginning of the year).

Given these limitations, the analysis generally supported the earlier findings regarding gains in student performance in IRI classrooms, particularly in Grades 1 and 2. The analysis reported that average effect sizes of student learning gains for the 37 IRI programs ranged from small losses (-0.16) to large gains (+2.19) across a variety of

subject areas, projects, and countries. For example, data collected from 2003 to 2007 showed that Grade 1 and 2 students participating in nine IRI English language programs made significantly greater gains in competency in Zambia, Sudan, Pakistan, and India compared to non-IRI learners (see Figure 2.1, below, taken from Ho and Thukral, 2009). The effect size reported for grade 1 students across all countries was 0.43 and for grade 2 students, 1.70 (ibid). When translated into percentile rankings, the results showed that had the average grade 1 control student participated in IRI, she would have been ranked in the 96th percentile at the time of year-end testing rather than the 50th; the 46 percentile "boost" in rank at year-end is attributed to the effectiveness of IRI instruction. In grade 2, the average control student would have been ranked in the 89th percentile had he participated in IRI English programming. The notably large effect sizes observed in Pakistan were included in these results and are further studied in the report.

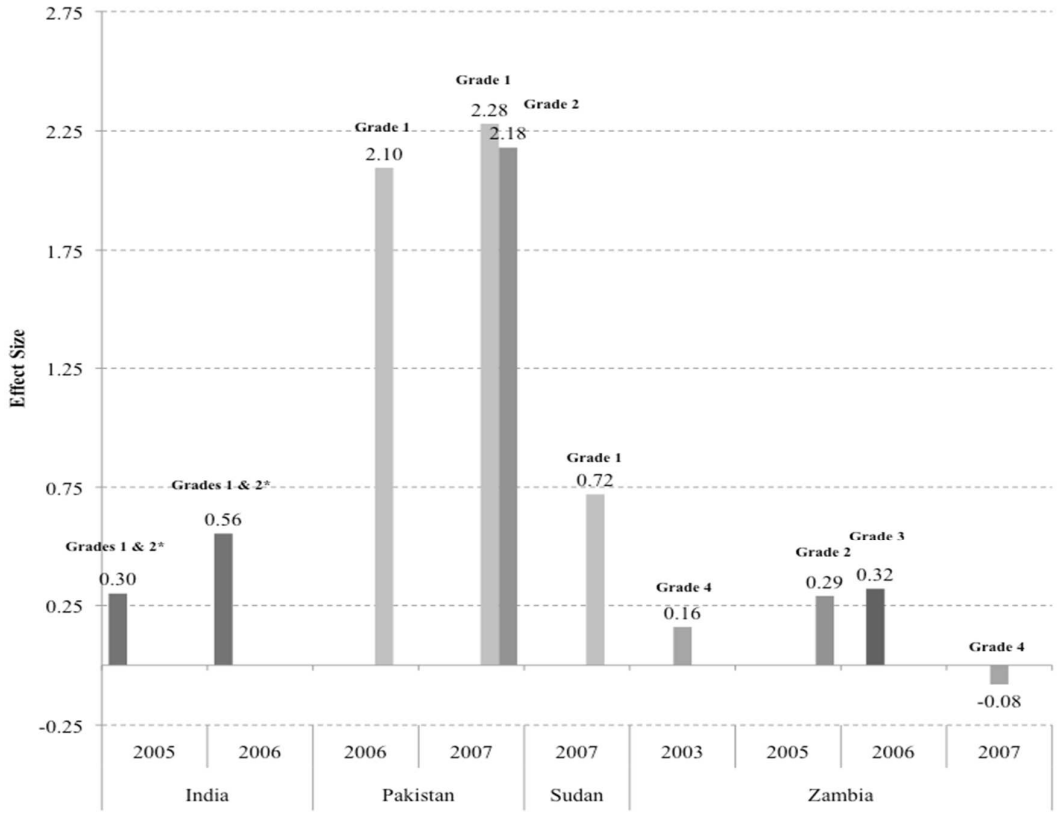


Figure 2.1 Effect Size Comparisons of IRI and non-IRI Student Test Scores in English Language in 4 Countries[7]

In two cases in Madagascar and Mali, IRI was used for teacher professional development instead of classroom instruction – focusing on building teachers' skills in active learning pedagogy and student-centered techniques. Observational data of teacher practice from these countries showed that, overall, "in both projects, teachers have been observed not only to have a better understanding of pedagogical concepts emphasized by broadcasts, but have also been evidenced to use active learning and student-centered techniques in lessons independent of radio guidance" (Ho & Thukral, 2009, p. 36). The change in teacher practice in Mali and Madagascar was based on the increased frequency

[7] Interpretations of effect size into percentile standing are provided by Cohen (1988). For example, an effect size (ES) of 0.0 indicates that the mean of the treated group is at the 50th percentile of the untreated group (i.e. 0% boost). An ES of 0.8 indicates that the mean of the treated group is at the 79th percentile of the untreated group (29% boost over a non-IRI student, who would rank at the 50th percentile).

with which a particular desired behavior was observed, comparing pre-IRI observations (i.e. observations prior to the start of the IRI programs) to post-IRI observations (i.e. observations following the end of the IRI series) of teacher practice. For example, with "general classroom practices," where items focus on observing student-centered teaching practices, grade 1 teachers in Madagascar demonstrated a 29 percentage point improvement from 2007 to 2008, and in grade 2, a gain of 30 percentage points. However, there was no control group for this study, as non-participating teachers were not observed.

Evaluations of *English is Fun* IRI in India

In India, EDC partnered with nine States to deliver instruction to students in grades 1 through 4 in mathematics, science and English language. In the early years of the project's IRI series for English language instruction, the pilot studies afforded comparisons between IRI and non-IRI students; in subsequent years, the IRI programs were scaled to the entire State, and precluded a comparison group. For the *English is Fun* IRI series, the first comparison of IRI and non-IRI learners test scores was reported for students in the State of Chhattisgarh. A comparison of post-test results showed that the average test score in English language competency for IRI students in Chhattisgarh in 2004-05 was 12 percentage points higher than their non-IRI peers (Royer, 2006).[8] Students were followed into their second year of participation in the same IRI series; results showed that the advantage among IRI learners almost doubled in grade 2, giving IRI students a 21 percentage point boost over their non-IRI peers (Ho & Thukral, 2009). Using Cohen's effect size criteria, the results from India demonstrated a medium effect

[8] Students who did not participate in the IRI interventions received their traditional course of English instruction from their teacher. This was assumed since time was allotted in student's schedules for English instruction although the extent of instruction in non-IRI classrooms was not monitored.

size for the *English is Fun* IRI program. As stated earlier, this study did not control for the level of in-class support received by teachers or measure the quality and quantity of instruction in non-IRI classrooms. Despite these shortcomings, the results were used to demonstrate the viability of the IRI program in improving learning outcomes for students, and were the basis for expansion to state-wide implementation in Chhattisgarh and other states.

Since 2004-2005, evaluations in India primarily reported gains for IRI students without a comparison group. Due to the increase in scale of the IRI interventions across the population, developers have relied heavily on the pilot results to justify continuation and expansion of the program. In 2009-2010, EDC conducted student assessments as well as teacher observations in IRI classrooms in the states of Rajasthan and Delhi. The purpose for conducting teacher observations in the same classrooms where students were tested was to monitor the implementation of the IRI programs and examine the relationship between teacher practice and student test scores.

In its final report (EDC, 2012), the project provided results of the impact of IRI on students and teachers separately. When the relationship between student outcomes and teacher practice were examined, the correlation between average frequency of practice on individual items and average student gain score was used. Specifically, the report finds that in Rajasthan, when teachers *always* conducted activities confidently in ways that were responsive to student learning needs (observation item: teacher facilitates the IRI lesson with confidence), students demonstrated significantly higher gains in English comprehension and speaking than their peers whose teachers demonstrated these behaviors *sometimes* or *never* (test statistics were not reported).

In Delhi, when teachers *always* demonstrated four desirable behaviors, students made significantly higher gains in speaking than when teachers demonstrated these desired

behaviors sometimes or never on the following observation items: a) teacher adequately able to follow instructions given by the radio characters; b) during pauses, teacher asks students questions in various ways to facilitate their understanding; c) teacher facilitates IRI activities in ways that are responsive to student's needs; d) teacher facilitates a positive environment in the classroom (test statistics were not reported).

The final T4 report provides a basis on which this study was conceptualized, particularly the limitations of the evaluation. While the report finds significant relationships between frequency of practice for one item and higher gains in student's English speaking and comprehension scores in Rajasthan and for four items in Delhi, the approach only examines a bivariate relationship between each observed behavior and average student outcomes. Consequently, there are three main shortcomings of the evaluation of *English is Fun* IRI program impact on teacher practices. First, the approach focuses on individual observed items rather than on teacher practice as a construct or set of practices of interest. While relationships were found between frequency of specific desired behaviors and gains in student test scores, the focus on individual items emphasizes just those practices instead of examining overall teacher practice in an IRI classroom. Second, the approach utilizes average student test scores in the class. The use of average student test scores in a class assumes that there is no variability within the classroom, when in fact variability exists both within and between classrooms in a nested structure. Methodologically, an alternative analytic approach that accounts for the nested nature of these data would provide more confidence about the internal validity of results. Third, the approach does not combine data for the two states to examine trends in teacher practice in an IRI classroom using the *English is Fun* IRI series, which may yield more generalizable results for the IRI series.

Summary

Across the IRI evaluations reviewed in this section, the impact of IRI participation on student outcomes and on teacher practice were usually examined separately. In India where the two were examined together, the approach has significant shortcomings. In the absence of such research on the impact of teacher practice on student outcomes in an IRI classroom, I describe the IRI methodology in general and the *English is Fun* IRI design in particular. I use archived documentation to describe the role that a classroom teacher in Delhi and in Rajasthan was expected to play in the IRI lesson. This description will serve as the framework for examining classroom observation data from Rajasthan and Delhi, and in turn to examine the influence of teacher practice on student outcomes.

The IRI Methodology

Interactive Radio Instruction programs are primarily intended to deliver instruction to students. The radio series are intended to be closely coordinated with the curriculum and provide a full course of instruction rather than serve as a supplement (Friend, 1985). The design of the *English is Fun* IRI series in Delhi and Rajasthan was no exception. In this section, I describe features of an evolving IRI design using the example of two of the earliest IRI programs developed for implementation in Nicaragua and Kenya.

The first step in the development of the 100 to 150 lessons in the IRI series is to translate the curriculum into a scope and sequence document, which is then used to develop scripts for each of the IRI lessons (Hartenberger & Bosch, 1996). Each script consists of ten to thirteen segments, with each segment separated by transition music. A segment either is an explicit instructional activity or recreational activity intended to provide students with time for physical activity or songs, with one or both segment types being derived from an objective in the existing curriculum. The written scripts are then

recorded into audio programs using local artists and actors. Generally, the pedagogical goals of the radio series are as follows (Friend, 1985; Moulton, 1994):

1. To provide instruction to students through tasks that they do (active learning).
2. Integrate the classroom teacher with the radio teachers, to make a 'teaching team'.
3. Provide a variety of activities to keep young children engaged.
4. Integrate regular repetition of previous concepts and practice for new concepts across short lessons over days, weeks or months (distributive learning).
5. Reinforce the correct response immediately following a student response.

Of interest to this study is the integration of the radio and classroom teacher – more specifically the presumed and actual roles of the classroom teacher in facilitating student learning during an IRI lesson.

IRI Methodology for Learning Mathematics in Nicaragua

A unique aspect of the IRI methodology is the reinforcement of responses following a student response. Friend (1985) discusses this aspect of IRI as one that was problematic in the early stages of development of the Nicaragua IRI Mathematics series. The author notes that in programmed instruction or computer-assisted instruction reinforcement is usually contingent upon the child's response – that is, a correct response is positively reinforced with a message such as 'good work' while an incorrect response triggers a remark such as 'not quite right; try again'. With radio, such contingent reinforcement is not possible due to the one-way nature of the medium (it is not possible to know whether the children responded or whether the response was correct). Furthermore, students are addressed as a group during an IRI activity and some students may answer correctly while others may not. The device that the IRI programs adopted in the end was to simply announce the correct answer to each exercise after the children were given an opportunity to respond (during a timed pause), and leave it to each child to

compare his own response with the announced correct answer. Friend (1985), Bosch (1997) and Potter & Naidoo (2013) note that this device worked remarkably well in the Nicaragua IRI Mathematics series, a technique that continued to be adopted by subsequent IRI programs.

A second technique utilized by the radio programs to facilitate student participation was the 'deferred response', an adaptation of the think-pair-share pedagogical tool. With this technique, students were asked to think of the answer to the question posed by the radio characters – in silence – but not to say it aloud until a further cue was given. Primarily developed to counteract the tendency of young children to mimic the immediate response of classroom leaders who would blurt out a response immediately following a question (sometimes called an 'echo' effect) this technique allowed additional time before children were requested to provide an answer. For example, children who were able to easily memorize answers to exercises like 3 + 4 may be the 'first responders'; but by deferring the response, the pause was timed to allow other children to count using fingers or tally marks to arrive at the same answer.

While the timed pauses and deferred response were devices used to overcome the one-way limitations of radio, the IRI methodology relies on a pedagogical approach described by Searle, Friend and Suppes (1978) as 'learning by example.'[9] Friend (1985) describes this approach as follows: "the development of a concept proceeds through a sequence of exercises and directed activities, which in turn serve as examples leading to a generalization" (p.3). While learning by example was the guiding theory for early IRI

[9] Although the evaluation conducted by Searle et al. was of a mathematics Interactive Radio Instruction series, the underlying foundation of the IRI approach is the same that is employed in more recent IRI programs. As a result, the analysis of the Mathematics IRI radio series is relevant to the English is Fun IRI series in India.

programs, the theory encountered added complications as IRI programs moved from promoting mathematics knowledge to language acquisition in Kenya.

IRI Methodology for Learning Language in Kenya

In an evaluation of the Radio Language Arts Program in Kenya, Christensen (1985) noted that the same approach as that used for Radio Mathematics was also employed for the teaching of language through radio, with some modification. In adapting the original approach for teaching radio to the teaching of language, the directed activities focused on mimicking the pattern-practice drill approach of mathematics instruction. For example, children would be asked to repeat (exactly or in slightly different form) information that had just been provided by the radio. The following excerpt of a script demonstrates this device:

> *The boy is walking around the chair.*
>
> *What is he doing?*
>
> [PAUSE FOR STUDENT RESPONSE – 4 SECONDS]
>
> *He is walking around the chair.*

This particular example for the teaching of language, however, also demonstrates the variety of correct responses the students can produce – from one-word responses (walking) to full sentence answers (he is walking) – that differed from mathematics instruction. The nature of responses in an IRI language program are of particular interest in the proposed study, and later in this chapter, I specifically explore the responses in an IRI series aimed at improving student's English proficiency using the World-class Instructional Design and Assessment (WIDA) standards for learning English as a Second Language (WIDA, 2013).[10]

[10] In 2002, a US educational grant provided initial funding for the organization that would become WIDA. Three states were involved in the grant: Wisconsin (WI), Delaware (D), and Arkansas (A), so the acronym

Another device used by the language programs was the deliberate integration of instruction and recreation (Friend, 1985). Compared to the mathematics lessons where recreation segments were used almost exclusively to provide relief from the often intense mental work required by the mathematical activities, the language programs used recreation segments to reinforce content from other segments through songs and games. In the mathematics programs, songs and games were also featured during the recreational segments but "with no serious intent to teach content" (Searle et al., 1978). In the language programs, game-like activities and songs were usually used to teach vocabulary, action verbs, and to provide opportunities for conversation in English.

One completely new device used in the IRI language programs was the use of verbal responses to sound cues, as demonstrated by the following excerpt:

> [SOUND EFFECT: BELL]
>
> *That's a bell.*
>
> [SOUND EFFECT: COW MOOING]
>
> *That's a cow.*
>
> [SOUND EFFECT: DOG BARKING]
>
> *That's a dog.*

The sound cues provided a common language to all students participating in the IRI programs, particularly in contexts where students may speak a number of local dialects. This device was first used in Kenya, where there are more than forty languages from three different language families. In Kenya, the IRI programs were implemented in schools where children and teachers did not always have the same mother tongue.

WIDA was chosen for the name. At the last minute, however, Arkansas dropped out, and World-class Instructional Design and Assessment was created to fit the acronym. As WIDA grew, however, the original name no longer adequately described its mission and WIDA decided to stop using the acronym definition; now WIDA just means WIDA.

In all, student participation during an IRI program included one or more of the following response types, distributed across the segments of each IRI lesson:

1. Oral responses, including recitation, singing, response to a question.
2. Physical response (eliciting the desired physical movement).
3. Deferred response (think time followed by a choral or physical response when cued).
4. Written response (written answer to a mathematical problem).

The devices used in the Kenya language program, compared to the mathematics program in Nicaragua, added devices and expanded the IRI methodology. Similarly, the use of IRI for language instruction also pushed the IRI methodology's conception of the role of the classroom teacher – a point I elaborate on next.

The Teaching Team

As with the *English is Fun* IRI series, the Nicaragua and Kenya IRI programs' primary goal was to deliver instruction to students. In delivering instruction to classroom students, the IRI design included the classroom teacher along with the radio teacher as the 'teaching team'. The various devices utilized by the radio programs to elicit spoken, physical, or written responses from students were also simultaneously intended to bring the teacher into the minute-by-minute teaching process during the IRI lesson (Anzalone & Bosch, 2005). In the IRI mathematics programs, the classroom teacher focused primarily on helping students with written responses or facilitating student activity during deferred responses (i.e. making sure all students were working on a solution to the problem, encouraging disengaged students, etc.). With the Kenya IRI program, the classroom teacher had to provide a wider range of support to students. As a result, the expectations for the classroom teachers' active role in instruction were greater in the language

programs, even though these programs sought to provide access to instruction that was primarily IRI driven.

Whereas the mathematics IRI programs relied primarily on choral responses and written activities, the language IRI programs opened the door to a wider range of response modes by the student, and thus took advantage of the classroom teacher's availability to step in at an appropriate time and work directly with the students to facilitate the radio lesson (Friend, 1985). For example, the correct response in an IRI language program may be a one-word or a full sentence response, thus posing a problem when scripting the reinforcement after the timed pause. Secondly, the range of acceptable answers could not be reinforced systematically by the radio character, so the burden of reinforcement fell on the classroom teacher.[11] With the emergence of IRI programs for teaching language, the conceptualization of the teacher's role necessarily expanded.

However, the designers recognized that the teacher's own knowledge may not be sufficient to cope with all the possibilities of student responses and needs, thereby posing another challenge in developing the scripts (Friend, 1985). Here, the IRI program had to meet the challenge of providing questions that were appropriate for the child to answer and appropriate for the teacher to reinforce. The Kenya IRI language program addressed the teacher's content knowledge (or lack thereof) in a written IRI guide. The IRI guidebook provided an overview of the activities in each daily lesson, along with a range of responses for questions posed by the radio program. By reviewing this guidebook prior to the beginning of the IRI lesson each day, the teachers were assumed to have a

[11] Reinforcement in IRI programs refers to the scripted answer that follows a pause. The scripted answer in the mathematics programs reinforced the expected response to the problem or question asked. In the language programs, the variety of responses to a question made it difficult to script an appropriate reinforcement since multiple correct responses were possible, from a single word answer to a full sentence.

foundational understanding of the content so that they were, at the very least, able to recognize correct responses from students during the IRI lesson.

The Dual-Audience Approach

The IRI methodology evolved with the expansion of IRI programs for teaching language in another way – in addition to providing content support to teachers in the IRI guidebook, the teacher was also targeted by the IRI lesson itself. In other words, the classroom teacher was integrated into the IRI lesson through a dual-audience approach, an approach that sought to promote not only the student learning but also teacher learning. Because teachers were thought to have relatively poor pedagogical skills, designers felt that the IRI program should also provide teachers with professional development or in-service training (Bosch, 1997). In the dual-audience approach, the IRI lesson addressed content to the students (the first audience) and modeled pedagogical techniques and content for the teacher (the second audience). As a result, the classroom teacher occupied two separate roles in the IRI language programs – first, as a member of the 'teaching team' who worked as an extension of the radio teacher; and second, as a recipient of pedagogical support or professional development from the radio teacher (Bosch, 2001). The IRI literature on the dual-audience approach addresses outcomes for teachers and outcomes for students separately, implying that there is a beneficial relationship between these outcomes. The expansion of the teachers role in the IRI classroom as a result of the dual-audience approach, particularly in the context of the *English is Fun* IRI series in India, and deliberately examining the relationship between teacher practice (an outcome for teachers in an IRI classroom) and student's English proficiency (an outcome for students in an IRI classroom) is the focus of this study.

Description of English is Fun IRI Series in India

In India, the *English is Fun* IRI programs were developed based on the English Curriculum for Primary Grades. Utilizing an approach similar to the IRI language programs in Kenya and later in South Africa, the *English is Fun* IRI series featured many of the same devices for learning language. As with the South Africa English programs, the India series differed from the Kenya and Nicaragua IRI series in that it not only adopted the dual-audience approach, it also expanded the role of the radio characters. Rather than having the radio and the classroom teacher functioning as the teacher, the radio was a 'door' to a world of fantasy characters that each contributed to the teaching of English. In contrast to the teaching of mathematics in Nicaragua, this rich cast of characters spanned all ages and included animals and fantasy characters, each serving a unique role in the teaching of English. Younger characters, for example, used English fluently and modeled for classroom students; older characters (including the radio teacher), animals and fantasy characters provided story-lines and context in which activities and the appropriate use of English was modeled for both students and teachers. To avoid confusion or discrediting the classroom teacher, only the radio teacher gave instructions to the classroom teacher.

By contrast, in the previous Kenya and Nicaragua series, a single radio teacher sang songs, lead activities and asked questions to the students in the classroom. In South African and in India, the radio teacher was now a group of radio characters, one serving as the 'teacher' and other characters playing the roles of children and community members. For example, in the India IRI series, the teacher is a woman who is responsible for answering all the questions of two young children, Chanda and Raju, and at times the trio meets with other characters who teach them about different topics and at times even find themselves in a classroom. With the introduction of a fantasy world, the India IRI

programs also featured more elaborate stories and character and plot-development that promoted tension and resolution – unlike the IRI series in Nicaragua and Kenya. In language instruction, the stories and fantasies created by the radio characters became an integral part of the language lesson, designed to engage students as well as teachers. Each *English is Fun* IRI program essentially functioned as a short drama complete with a storyline and plot, characters, variety, pace, songs and games.

While the use of IRI for teaching English in South Africa and in India cued the expansion of the role of the classroom teacher and of the cast of radio characters that delivered the content, the overall goal of the *English is Fun* IRI series remained the same as its predecessors: to deliver English language instruction to students in primary grades. However, the dual audience approach of the IRI methodology, as well as project documentation, suggested that a secondary goal of the IRI intervention in Delhi and Rajasthan was to influence teacher practice.

To examine these two project goals – the primary goal of providing direct English instruction to students and the secondary goal to provide implicit training to classroom teachers through modeling by the radio characters – I first examine how student performance and teacher practice were described and measured. I begin by examining student's English proficiency using the WIDA framework for learning English as a Second Language (ESL).

Student's Proficiency in English

As with earlier IRI series, students participating in the *English is Fun* IRI series produced a variety of responses, including verbal responses (deferred, choral, of varying length) and physical responses (doing the desired action when cued). Unlike earlier IRI series, no written responses were required of students in the *English is Fun* programs. Student proficiency levels were assessed using two tests – a comprehension test and a

speaking test. Although these two tests capture the types of skills that students were expected to build, the verbal responses in the speaking test include simple words as well as more complex sentence speaking. In order to better understand the nature of student's verbal and physical responses as a result of participating in the *English is Fun* IRI lesson, and because student responses are of interest in this study, I apply a framework used to study English language acquisition among students learning English as a second language in the U.S. I first describe the WIDA Features of Academic Language for students learning English as a Second Language (ESL). In the next chapter, I apply the WIDA scoring model to the outcomes measured for students listening to the *English is Fun* IRI programs.

Although the WIDA model was not used in the development or evaluation of IRI programs, I use it in this study as an analytical lens to further describe the forms of student proficiency in English as a result promoted or valued by the *English is Fun* IRI series. I propose that this lens is appropriate since the IRI series also sought to teach English to students whose native language was not English.

The WIDA Framework

The WIDA framework is a useful tool for characterizing the nature of students' responses in the *English is Fun* IRI series since it assesses learners' readiness to perform successfully in English in an academic context (WIDA, 2012). The WIDA framework is commonly used by local education agencies in the United States to guide instructional design and placement of ESL students in the U.S. Based on the work of Jim Cummins who distinguished between English spoken in classrooms and English spoken on the playground, the WIDA framework recognizes two discourse types – Cognitive Academic Language Proficiency (CALP) and Basic Interpersonal Communication Skills (BICS). Building on this framework, there is general consensus regarding the English language

skills required by students to manage "new sociocultural and language routines in classrooms and schools" while making use of specialized vocabulary, grammar, language functions and related discourse structures and text types (WIDA, 2012). Definitions are provided for Listening, Reading, Speaking and Writing for three levels – ranging from word/phrase (simple) to sentence and discourse (most complex) (see Figure 2.2 for the WIDA performance Definitions for Listening and Reading). Generally, the framework presumes an average timespan of 5 years for learners who enter at the simplest level to mature in their command of more complex levels of discourse, although timeframes reportedly vary across education agencies and student groups.

WIDA Performance Definitions Listening and Reading, Grades K–12

WIDA

At each grade, toward the end of a given level of English language proficiency, and with instructional support, English language learners will process…

	Discourse Level	Sentence Level	Word/Phrase Level
	Linguistic Complexity	**Language Forms and Conventions**	**Vocabulary Usage**
Level 6 – Reaching Language that meets all criteria through Level 5, Bridging			
Level 5 Bridging	• Rich descriptive discourse with complex sentences • Cohesive and organized related ideas	• Compound, complex grammatical constructions (e.g., multiple phrases and clauses) • A broad range of sentence patterns characteristic of particular content areas	• Technical and abstract content-area language • Words and expressions with shades of meaning for each content area
Level 4 Expanding	• Connected discourse with a variety of sentences • Expanded related ideas	• A variety of complex grammatical constructions • Sentence patterns characteristic of particular content areas	• Specific and some technical content-area language • Words and expressions with multiple meanings or collocations and idioms for each content area
Level 3 Developing	• Discourse with a series of extended sentences • Related ideas	• Compound and some complex (e.g., noun phrase, verb phrase, prepositional phrase) grammatical constructions • Sentence patterns across content areas	• Specific content words and expressions • Words or expressions related to content area with common collocations and idioms across content areas
Level 2 Emerging	• Multiple related simple sentences • An idea with details	• Compound grammatical constructions • Repetitive phrasal and sentence patterns across content areas	• General and some specific content words and expressions (including cognates) • Social and instructional words and expressions across content areas
Level 1 Entering	• Single statements or questions • An idea within words, phrases, or chunks of language	• Simple grammatical constructions (e.g., commands, Wh- questions, declaratives) • Common social and instructional forms and patterns	• General content-related words • Everyday social and instructional words and expressions

…within sociocultural contexts for language use.

Figure 2.2 WIDA Performance Definitions for Listening and Reading (WIDA, 2012)

Using the WIDA definitions for listening and speaking as a guide, the spoken responses elicited by students participating in the *English is Fun* IRI series places the

intervention primarily at Level 1 of the WIDA framework. Specifically, the IRI lessons expose students to content-related words in English as well as build their vocabulary usage in everyday social and instructional words and expressions, as shown in the following example of an excerpt from an IRI script:

> Raju: That song makes me *happy*.
>
> Chanda: *Happy?* What is *happy?*
>
> Teacher: Raju, Chanda, happy is the English word for 'khush'. [translated for the benefit of the reader] When we are 'khush', in English we say 'happy'.
>
> Teacher: Students, if you're feeling happy today, say "I'm happy".
>
> PAUSE: 3 SECONDS
>
> Raju: I'm happy! I am 'khush'!

At the sentence level, the lessons build students' ability to understand and speak simple grammatical constructions and common social and instructional forms and patterns, as shown in this excerpt:

> Teacher: Students, let's use the vocabulary we have learned today in complete sentences. We will do an activity about feelings. I will start by saying how I feel today, then it will be Chanda's turn. Teacher, please select a student who will go after Chanda.
>
> PAUSE: 3 SECONDS
>
> Teacher: Ready, everyone? Let's play. Today, I am feeling sad.
>
> Chanda: Today, I am feeling glad!
>
> PAUSE: 10 SECONDS
>
> Teacher: Good! Teacher, let's continue this activity with more students in the class. You will have 30 seconds; please ask students from around

the classroom to take turns using the vocabulary words from today's lesson. You may have already copied the words on the board from your teachers guide for this activity.

PAUSE: 30 SECONDS

SOUND: ACTIVITY END BELL

Finally at the discourse level, single statements or questions are posed to the listeners, demonstrated in this excerpt:

Teacher: Boys and girls, today Raju and Chanda are going to listen to a story from the village storyteller. Listen carefully to this tall tale because your teacher will ask you questions after the story is finished. Remember to pay close attention to the words and phrases that Raju and Chanda learn in English.

[story segment, 1 minute 20 seconds]

Raju: Chanda, that was a great story, I can't wait to see what our friends remember!

Teacher: Boys and girls, I'm glad you were paying close attention. Now, tell me, what was the village storyteller's favorite phrase?

PAUSE: 5 SECONDS

Chanda: Oh I know! He always says 'all is well'!

Unlike the goals of the WIDA framework to move students from Level 1 to Level 6 English language proficiency in speaking, listening, reading, and writing, the goals of the *English is Fun* IRI programs were more modest, to build foundational English listening and speaking skills. As such, the WIDA framework presents a broader context within which to understand past and current IRI series that seek to promote language

acquisition. For the IRI series that is the focus of this study, the scoring rubric utilized by WIDA is the most relevant aspect of the framework since it can be used to examine the nature of student responses in the IRI classroom across the two assessments that were administered. I now describe the WIDA scoring model and the IRI assessments to which I apply the WIDA model.

WIDA's ACCESS for ELL Scoring Framework

The Assessing Comprehension and Communication in English State to State for English Language Learners (ACCESS for ELLs) is a large-scale English proficiency test for K-12 students developed by WIDA. The purpose of the test is to monitor student progress toward English proficiency on an annual basis and provide a criterion for determining when a student has attained language proficiency comparable to that of their English-proficient peers. The test relies on the social and academic language demands within the school setting as defined by the WIDA Performance Definitions (discussed above). The test is a reliable and valid measure of English language proficiency, and its scoring rubric is particularly useful for this study since the IRI assessments were developed to test proficiencies in English speaking and comprehension skills. By applying the WIDA scoring framework, student's speaking test scores can be disaggregated to examine the nature of student's responses from the word/phrase level to sentence level.

As shown in Figure 2.3, the overall composite score for the ACCESS for ELLs assessment consists of the listening, speaking, reading, and writing scores. Since the IRI programs focused on listening and speaking skills only, the oral language composite score is of most interest to the IRI analysis.

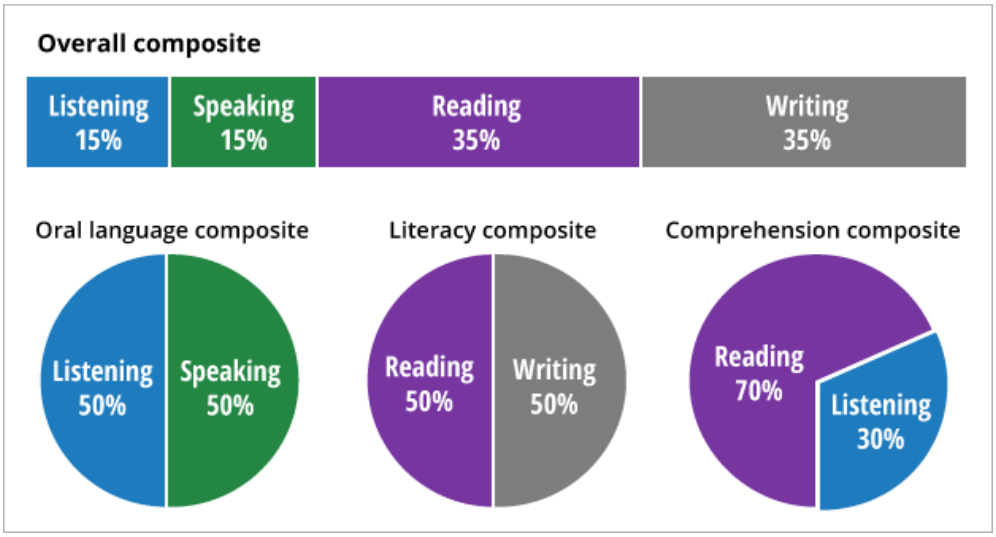


Figure 2.3. ACCESS for ELLs Scoring Framework

The listening score for the IRI learner is primarily comprised of the listening comprehension items in the IRI assessment. The speaking score, however, can be disaggregated further into vocabulary (word/phrase level) and sentence usage (sentence and discourse level). By disaggregating student's speaking test scores into the functional areas prescribed by the WIDA performance definitions, a more granular analysis of students' English speaking proficiency can be performed. In sum, the combination of the WIDA performance definitions and the WIDA ACCESS for ELL's scoring framework provides a model for examining English proficiency in the IRI context and for understanding the forms of English language proficiency promoted by the IRI programs.

Thus far, this review of the literature has focused on the IRI methodology, the manifestation of the methodology in the *English is Fun* IRI series, and a framework for examining English proficiency levels of students participating in the *English is Fun* IRI series. While this information provides a necessary backdrop for the IRI program and a model for examining student's performance in English proficiency skills, the focus of this study is the role of the teacher in the *English is Fun* IRI classroom.

The expansion of the teacher's role in the IRI language programs indicated, at least implicitly, that the classroom teacher was not expected to play only a supportive role in the daily implementation of the IRI lessons; rather, teachers were expected to play a more active role in instruction. To describe the role that was ascribed to classroom teachers participating in the *English is Fun* IRI programs in Delhi and Rajasthan, I begin with an examination of IRI training materials developed by EDC followed by project documentation of the *English is Fun* IRI series. Using the description of the teacher's role as a starting point, I then translate the teacher's role into expectations of teacher practice into explicit and implicit roles embedded in the dual-audience design of the *English is Fun* series.

The Role of the Classroom Teacher

In the preceding review of the IRI mathematics and language programs, two features of the IRI programs were discussed – the teaching team and the dual-audience approach. In this section, I further examine these two features as they relate to the classroom teacher in the *English is Fun* IRI series in India. Specifically, I examine how the expanded role of the classroom teacher in the IRI methodology manifested itself in IRI classrooms in Delhi and Rajasthan.

Classroom Teacher's Role as a Member of the 'Teaching Team'

Training materials developed by EDC discuss the expanded role of the classroom teacher in the teaching of language using IRI. As an extension of the radio teacher, the classroom teacher is viewed as part of a 'teaching team' that is similar to a co-teaching model in a face-to-face setting (with one teacher as lead teacher and the other as a co-teacher) (Bosch, 1997). In comparison to a face-to-face co-teaching model where both teachers are present in the classroom with the students and the dynamic between the two

teachers can vary across situations and content, the IRI approach dictates a more predictable dynamic between the classroom teacher and the radio teacher. This predictable co-teaching relationship is a result of two limitations – first, that the radio teacher will never have the luxury of hearing or seeing the activities being done by the students; and second, that the classroom teacher is generally assumed to have little to no content knowledge. As such, the IRI methodology assumes a 'teaching team' model in which the classroom teacher takes the lead on classroom management and in leading activities with students, while the radio teacher takes the instructional lead (Hartenberger & Bosch, 1996).

This conceptualization of the classroom teacher's role was evidenced in IRI training materials as well as in project documentation for the *English is Fun* IRI program in India. Project documentation suggests that the classroom teacher functioned as a member of the 'teaching team,' but that this role was limited, at least explicitly, by several project parameters. Specifically, the extent to which the teacher fulfilled the role of a member of the teaching team was limited by the number of training days available to prepare teachers for the IRI programs and the general assumption that teachers had insufficient proficiency in English or knowledge of how to teach students a second language.

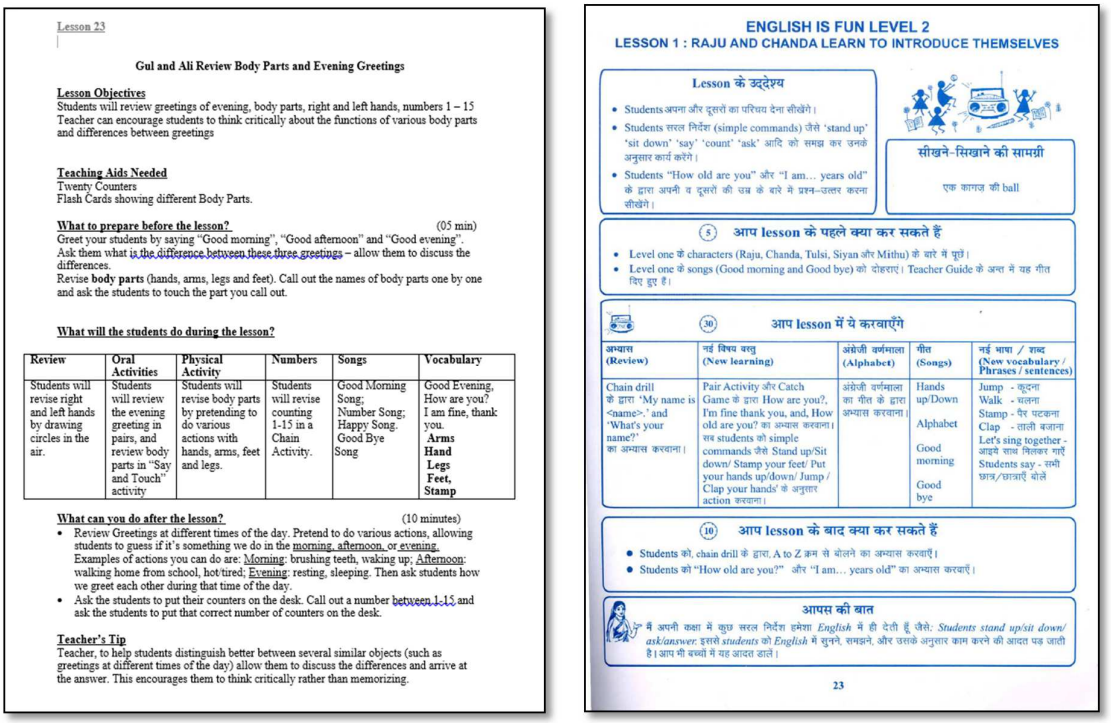
Prior to the start of the *English is Fun* IRI series in each academic year, classroom teachers were provided with face-to-face training to prepare them for participation in the IRI program in the upcoming school year. This training often occurred during the summer months and as part of 20 days of training that teachers received on a variety of topics (one of which was IRI). During the five days of training held in Rajasthan and in Delhi, teachers were introduced to the goals of the IRI programs, familiarized with the various types of activities in the IRI lessons, and provided opportunities to practice an IRI lesson.

Teachers did not receive additional face-to-face training beyond the initial five-day training; any further support was only provided through the content in the Teachers Guide and in the IRI lessons themselves.

This short training timeframe was particularly important to Government officials in Delhi and Rajasthan since it indicated a quick implementation timeline and limited costs for teacher training if the Government was to assume responsibility for the IRI program after the end of the T4 project (H. Thukral, personal communication, May 20, 2014). The short timeframe for the training also indicated to teachers that in order to implement the IRI lessons in their classrooms, basic skills were needed. As such, the objectives of the five-day training were to prepare teachers to: a) operate the technology (radio), such as turning on the radio, tuning to the correct frequency, ensuring that batteries are charged; b) collect the materials needed for the upcoming lesson, c) set up the classroom and students so that all students are within listening range, and d) review the content in the upcoming lesson, as described in the Teachers Guide, so they are able to recognize and reinforce students responses.[12] Beyond setting up the classroom and the materials, teachers were also trained to follow instructions that were directed to them during the IRI lesson.

On one hand, the training and project documentation suggest that classroom teachers in Delhi and Rajasthan were expected to set up the radio and the classroom and to follow instructions directed to them by the radio teacher. On the other hand, the Teachers Guide suggested a more involved role for the classroom teacher. For each lesson, the Teachers Guide provided critical information necessary for the teacher to *facilitate* the day's IRI lesson (a sample guide in English and in Hindi is provided in Figure 2.4).

[12] The teacher's responsibilities in making these logistic arrangements are reinforced in the teacher training and in the Teacher's Guide. The Teacher's Guide is a handbook that details the topics and activities that will be covered in that day's 30-minute lesson, the materials that will be required for the planned activities, as well as suggestions for review activities the teacher can do before and after the broadcast.



Lesson 23

Gul and Ali Review Body Parts and Evening Greetings

Lesson Objectives
Students will review greetings of evening, body parts, right and left hands, numbers 1 – 15
Teacher can encourage students to think critically about the functions of various body parts and differences between greetings

Teaching Aids Needed
Twenty Counters
Flash Cards showing different Body Parts.

What to prepare before the lesson? (05 min)
Greet your students by saying "Good morning", "Good afternoon" and "Good evening".
Ask them what is the difference between these three greetings – allow them to discuss the differences.
Revise **body parts** (hands, arms, legs and feet). Call out the names of body parts one by one and ask the students to touch the part you call out.

What will the students do during the lesson?

Review	Oral Activities	Physical Activity	Numbers	Songs	Vocabulary
Students will revise right and left hands by drawing circles in the air.	Students will review the evening greeting in pairs, and review body parts in "Say and Touch" activity	Students will revise body parts by pretending to do various actions with hands, arms, feet and legs.	Students will revise counting 1-15 in a Chain Activity.	Good Morning Song; Number Song; Happy Song. Good Bye Song	Good Evening, How are you? I am fine, thank you. **Arms Hand Legs Feet, Stamp**

What can you do after the lesson? (10 minutes)
- Review Greetings at different times of the day. Pretend to do various actions, allowing students to guess if it's something we do in the morning, afternoon, or evening. Examples of actions you can do are: Morning: brushing teeth, waking up; Afternoon: walking home from school, hot/tired; Evening: resting, sleeping. Then ask students how we greet each other during that time of the day.
- Ask the students to put their counters on the desk. Call out a number between 1-15 and ask the students to put that correct number of counters on the desk.

Teacher's Tip
Teacher, to help students distinguish better between several similar objects (such as greetings at different times of the day) allow them to discuss the differences and arrive at the answer. This encourages them to think critically rather than memorizing.

ENGLISH IS FUN LEVEL 2
LESSON 1 : RAJU AND CHANDA LEARN TO INTRODUCE THEMSELVES

Lesson के उद्देश्य
- Students अपना और दूसरों का परिचय देना सीखेंगे।
- Students सरल निर्देश (simple commands) जैसे 'stand up' 'sit down' 'say' 'count' 'ask' आदि को समझ कर उनके अनुसार कार्य करेंगे।
- Students "How old are you" और "I am… years old" के द्वारा अपनी व दूसरों की उम्र के बारे में प्रश्न–उत्तर करना सीखेंगे।

सीखने-सिखाने की सामग्री
एक कागज़ की ball

(5) आप lesson के पहले क्या कर सकते हैं
- Level one के characters (Raju, Chanda, Tulsi, Siyan और Mithu) के बारे में पूछें।
- Level one के songs (Good morning and Good bye) को दोहराएं। Teacher Guide के अन्त में यह गीत दिए हुए हैं।

(30) आप lesson में ये करवाएँगे

अभ्यास (Review)	नई विषय वस्तु (New learning)	अंग्रेजी वर्णमाला (Alphabet)	गीत (Songs)	नई भाषा / शब्द (New vocabulary / Phrases / sentences)
Chain drill के द्वारा 'My name is <name>.' and 'What's your name?' का अभ्यास करवाना।	Pair Activity और Catch Game के द्वारा How are you?, I'm fine thank you, and, How old are you? का अभ्यास करवाना। सब students को simple commands जैसे Stand up/Sit down/ Stamp your feet/ Put your hands up/down/ Jump / Clap your hands' के अनुसार action करवाना।	अंग्रेजी वर्णमाला का गीत के द्वारा अभ्यास करवाना।	Hands up/Down Alphabet Good morning Good bye	Jump - कूदना Walk - चलना Stamp - पैर पटकना Clap - ताली बजाना Let's sing together - आइये साथ मिलकर गाएँ Students say - सभी छात्र/छात्राएँ बोलें

(10) आप lesson के बाद क्या कर सकते हैं
- Students को, chain drill के द्वारा, A to Z क्रम से बोलने का अभ्यास करवाएँ।
- Students को "How old are you?" और "I am… years old" का अभ्यास करवाएँ।

आपस की बात
मैं अपनी कक्षा में कुछ सरल निर्देश हमेशा *English* में ही देती हूँ, जैसे: *Students stand up/sit down/ ask/answer.* इससे *students* को *English* में सुनने, समझने, और उसके अनुसार काम करने की आदत पड़ जाती है। आप भी बच्चों में यह आदत डालें।

23

Figure 2.4. Teacher's Guide for Lesson 23 in English and Lesson 1 in Hindi

In each daily IRI lesson, a page of the Teachers Guide was dedicated to providing the classroom teacher with the necessary English content knowledge (vocabulary words in English with their meanings in Hindi), descriptions of the pedagogical and classroom management techniques that would be featured in the lesson, as well as ideas for pre-broadcast and post- broadcast activities to review content. Beyond the information provided to teachers in the Guide, a review of the Classroom Observation Tool further confirmed that the information in the Teachers Guide may not have been purely informative; instead, teachers were in fact expected to go beyond what they were trained on. The Classroom Observation Tool was used to document classroom teachers' practice during the IRI lesson during intermittent classroom visits by project staff. The presence of the additional information in the Teachers Guide and the presence of items in the Classroom Observation Tool on teacher practice *during* the IRI lesson, together, suggest

that classroom teachers in Delhi and Rajasthan were expected to play a more involved role in the IRI classroom than those that they were explicitly trained on.

To describe this additional role for the classroom teacher, I begin with a discussion of the dual audience approach of the IRI design, the basis for this second role. I then examine the expectations of teachers using the Classroom Observation Tool as evidence of a more expanded, if not implicitly stated, role. Finally, to contextualize this secondary role, I examine the design and implementation of the *English is Fun* IRI series in Delhi and Rajasthan.

The Classroom Teacher's Role in the Dual-Audience Approach

In the IRI methodology, the 'dual-audience' approach casts the teacher with a second role in the IRI classroom – that of a learner, or recipient of instruction. Through this second role, the IRI design addresses the issue of poor content knowledge among teachers (a known concern in most developing contexts) by providing in-service professional development via the daily radio lessons that are already delivering instruction to students. This secondary feature of the IRI program is common in more recent applications of IRI for student learning (by contrast, the use of IRI for purely teacher professional development, as with Madagascar and Mali, does not follow such a dual-audience approach).[13]

Hartenberger and Bosch (1996) describe this indirect approach to teacher training as one in which classroom teachers are guided through the process of learning (i.e. activities, games, songs) and are asked to play lead roles in classroom activities. The characters on the radio program model pedagogical techniques and behaviors for the

[13] Recent IRI, or Interactive Audio Instruction (IAI), which expand the delivery of instruction from radio broadcast to a digital format available to teachers on-demand (using tablets, iPods, or CD), also feature the dual-audience approach. Examples of such programs include IRI programs in Indonesia, Somalia, Haiti, and others (EDC, 2015).

classroom teacher in the context of activities or games – these are the types of behaviors that the program views as desirable and advocates teachers to adopt in their own practice. Similarly, the radio characters build teachers' content knowledge alongside student learning.

In the *English is Fun* IRI series, the classroom teacher's poor content knowledge is addressed through the Teachers Guide and through the modeling they are exposed to as a result of continued participation in the IRI lessons. The Teachers Guide and Classroom Observation Tool used in Delhi and Rajasthan suggest that this exposure was deliberate – that teachers' practice and content knowledge was expected to improve as a result of participating in the IRI lessons. Specifically, over the course of the IRI series, the items in the Classroom Observation Tool measured the frequency with which teachers demonstrated desirable behaviors – both in the facilitation of student learning during the IRI lesson and in their own improvement in English speaking and comprehension skills.

The expectation that teacher practice would change as a result of participating in the *English is Fun* IRI lessons was grounded in findings from previous research on teacher practice in Chhattisgarh where a similar English IRI series was being implemented (Royer, 2006a).[14] In 2006, Royer used observation data from teachers in Chhattisgarh during both IRI and non-IRI lessons to examine whether teachers mimicked the pedagogical techniques and behaviors that were being modeled for them in the IRI lesson. Royer found that there was a transference of practices and behaviors to other subjects taught by the IRI teachers (Royer, 2006a). The study did not control for exposure to pedagogical techniques and behaviors outside of the IRI program.

[14] The IRI series in Chhattisgarh was the pilot of the *English is Fun* IRI series that would later be adapted and expanded for use in Delhi and Rajasthan.

The Role of the Teacher According to the Classroom Observation Tool

The Classroom Observation Tool developed to observe teachers during the 2009-2010 IRI programs in Delhi and Rajasthan was developed using similar items used by Royer (2006a, 2006b, 2006c & 2006d). The Classroom Observation Tool used in Delhi and Rajasthan included items based on a) the IRI training that teachers received and b) behaviors and practices that program staff expected teachers to mimic based on prior research and the content of the IRI lessons. Taken together, the Observation Tool reflects what teachers were explicitly trained to do in the trainings held in Rajasthan and Delhi in 2009-2010 as well as practices and behaviors that they were implicitly expected to do as a result of findings from prior research.

The purpose of the Classroom Observation Tool was two-fold – in the earlier part of the year, project staff used this tool to monitor the progress of IRI implementation according to the training that teachers were provided prior to the beginning of the programs. Specifically, observers were trained to identify challenges that teachers were facing in fulfilling the primary expectations placed upon them in the five-day IRI training. When an observer found that the teacher had not adequately set up the classroom or students, or was unable to follow the directions to them by the radio characters, the observer would stop the observation and instead provide hands-on support. As a result, in the early part of program implementation, the observer did not function solely as an observer but also as a coach. Once the program staff felt that significant challenges were addressed, the observers functioned solely as observers. The data collected using the observation tool during the latter half of the IRI program, therefore, provides evidence of actual teacher practice in the IRI classroom – without observer intervention – the main variable of interest in my study.

For the purposes of this study, I first group the items from the Classroom Observation Tool into two groups –a set of expectations based on the training that teachers received and a set of expectations based on the Teachers Guide and the dual-audience design. I then use the data for teachers in Rajasthan and Delhi to estimate the extent to which they satisfied each of these sets of expectations; and in turn, the influence of their practice on student outcomes.

The Role of the Teacher According to the English is Fun Design

Thus far I have examined the role of the classroom teacher according to the IRI design – specifically, from the perspective of the IRI methodology and the Classroom Observation Tool. I now turn to examining the role of the classroom teacher from the perspective of the professional development they received. Under professional development I include both the five-day training that teachers received prior to the start of the IRI programs as well as the in-service training via IRI lessons. This perspective is important to examine because it establishes that the expectations of teachers in an IRI classroom in Delhi and Rajasthan were not only evident in the data collection tools used but were also purposeful in the design of the IRI series itself. Using this perspective, I find that the two sets of expectations for the classroom teacher were grounded in some form of professional development that was intentionally provided to the classroom teacher – whether it was explicit as part of the five-day teacher training at the beginning of the IRI program or implicit in the Teacher's Guide or in the year-long in-service modeling of techniques and behaviors in the 120 IRI lessons.

A requirement of the IRI series in Delhi and in Rajasthan was that teachers should be able to facilitate the IRI program with five days or less of training – this requirement aligned with the primary goal of the project to deliver instruction to students at scale; and assuming that teacher capacity was poor, to deliver the instruction primarily through the

radio teacher. While this allowed the primary expectations to be covered in the IRI training itself, the secondary role teachers were expected to play (as evidenced in the Classroom Observation Tool and in the Teacher's Guide), would have to be addressed through the in-service approach.

This in-service modeling was delivered through the daily IRI lessons, with radio characters providing an increasing amount of content support and modeling of pedagogical techniques and behaviors with each IRI lesson. For example, a review of the scripts and scope and sequence documents shows that in week one, the following activity was used to model pairing: students were paired into three groups, with each group given an alphabet letter to say and sound out; the teacher monitored student's participation and whether they said and sounded their assigned letters correctly in the group.

In week five, the following activity was used to model student's use of vocabulary words, in pairs: students were paired by two's, with each pair asking and answering simple questions such as "what is your name?" or "how old are you?" In this activity, the teacher not only was managing smaller groups of students working together in the class (multiple pairs versus 3 large groups in week one), but was also drawing on and using English vocabulary taught and pedagogical techniques modeled in weeks one to five. The teacher's ability to use the vocabulary, pedagogical techniques and manage the classroom, simultaneously, were necessary for the teacher to be able to reinforce student's responses (which could range from single word answers to complete sentences).

The proportion of time during which the teacher was facilitating learning in the classroom also changed over the course of the IRI series. In earlier lessons, the length of the pause (during which the teacher is essentially on her own to implement the activity that has been modeled) was no longer than 20 seconds. The shorter pauses allowed the

designers to ensure that, even when a teacher did not understand or was not able to conduct the activity as modeled, there were multiple other opportunities to reengage with the lesson. In later lessons where additional time was necessary – particularly when the teacher had to do multiple things, such as pair students, explain the activity, then monitor the activity – longer pauses were provided, even up to one minute.[15] As such, the classroom observation data from the latter half of the IRI series (and that are used in this study) presumably capture teacher practice when the modeling included not only basic classroom management but also techniques to facilitate student's understanding and use of English.

Information and Communication Technologies in Education

In this section, I move from the IRI literature to the broader ICT literature. From the IRI literature I characterized the role of the classroom teacher as it was envisioned in the design of the *English is Fun* IRI program. From the broader ICT literature I examine what this role *might* be given what is known today about ICTs in education.

Using two bodies of ICT studies – one regarding the use of technology to increase access to instruction and another regarding the use of technology in a face-to-face classroom, I attempt to understand the explicit and implicit goals of the *English is Fun* IRI series. On the one hand, the radio-based programs presented an option that delivered English content to students with little dependence on the classroom teacher for instruction – it leverages the dissemination abilities of ICTs; on the other hand, the dual-audience approach of the IRI programs brings the classroom teacher into the fold by addressing the

[15] In later lessons, teachers were still provided with support in case they did not fully understand the activity or had trouble with the vocabulary – through the Teacher's Guide.

gap in their skills – here, the ICT plays a role in the classroom along with the teacher and the student, and is viewed as an instructional technology.

These two bodies of literature provide important distinctions that situate this study. I first examine the role of the teacher in dissemination technologies, such as online courses that advocates propose to help alleviate teacher shortages. Second, I examine the role of the teacher in instructional technologies, such as computers in a face-to-face classroom. Finally, I discuss a possible role for the teacher in an IRI classroom based on my examination of the literature.

ICTs to Address Teacher Shortages: Dissemination Technologies

Online learning, such as Massive Open Online Courses (MOOCs), represent one use of technology for dissemination – it makes it possible for learning to occur at a distance. One advantage of MOOCs is that it can deliver content to learners without the need for the teacher and learner to be in the same time and space. This separation of time, space and content presents an opportunity where teacher availability is scarce. In the U.S., aggregate surpluses in teacher staffing masks chronic and acute teacher shortages in specific grade levels (secondary and higher education), content areas, and geographic regions (Dwinal, 2015). Dwinal (2015) suggests that online learning presents an opportunity to fill those entrenched vacancies. By providing a teacher-led instructional experience, MOOCs offer learning opportunities at scale, especially to populations affected by teacher shortages.

While MOOCs, or in general, online courses, increase access to instruction, the pedagogy underlying MOOCs is not absent of the teacher-student relationship. Online learning unbundles the education experience for both teachers and students giving both a high-level of flexibility. However, the personal contact between teacher and student has

been addressed as an essential element for good coaching and development, even in online courses (Thille, 2014). In a review of MOOC platforms and pedagogy in the United Kingdom, Bayne and Ross find that the role of the teacher as a guide persists in the MOOC (2014). Although the teacher delivers instruction through pre-recorded lectures, the teacher-student interaction is supported through online forums, and an increasing reliance on one-to-one communication through email. Even today, MOOCs pedagogical underpinnings and platforms continue to be adapted to increase its ability to deliver the learning experience – but the need for, and incorporation of, guidance from the teacher appears to be an aspect that will remain (Bayne & Ross, 2014).

ICTs to Support Face-to-Face Instruction: Instructional Technologies

Information and Communication Technologies are also used as part of a classroom where teachers and students interact face-to-face. Many technologies occupy this space, with teachers and students today using computers, tablets, mobile phones, and projectors – not to mention the multitude of online tools and mobile and tablet applications on these technologies (Toyama, 2015). To examine the role of the teacher in instructional technologies, I draw from a commonly used conceptual framework that researchers have used in the past two years to study ICT use in classrooms. In doing so, I use the framework as evidence of the role that the classroom teacher is expected to play in these ICT classrooms.

Koehler and Mishra's Technology, Pedagogy and Content Knowledge (TPACK) framework "articulates the role of technology in the process of teaching and learning in an integrated manner" (Abbitt, 2011, p. 283). Treating technology as an integral component of the teaching and learning process versus an 'add-on', the framework focuses on the connections among technology, content and pedagogy as they play out in classroom

contexts (Koehler & Mishra, 2009, p. 67). What is most important in the framework's approach is its ecological approach to studying the complex teaching and learning process – with the teacher an integral part of that ecosystem (Hoffer, 2008).

Generally, the TPACK framework has been used to examine two research questions since its development: (1) what teachers learn; and (2) what teachers do. Prior to the TPACK framework, Hoffer (2008) notes that ICT studies "worked around the periphery." Specifically, he notes that studies attempted to understand the process of technology adoption by identifying where teachers faced difficulty in the process and challenges with each type of technology. By identifying roadblocks along the adoption process, these studies had begun to identify that the underlying teacher practice required further examination (Buendia, 2002; Cilesiz, 2010; Zhao & Frank, 2003). In turn, the TPACK brings central to the study the interactions between teacher's current practice (i.e. their content knowledge and pedagogical knowledge) and their technological knowledge.

According to the TPACK wiki (Koehler, 2012), there has been a surge of scholarly inquiry into the use of ICTs in the classroom using the TPACK tool, citing well over 500 publications and presentations related to the framework. Across these studies, the TPACK framework brings focus to the interaction between teacher and technology as a necessary piece to understand first if and how an ICT affects student learning. In other words, these studies highlight the importance of the classroom teacher's pedagogical practice and that ICTs function to amplify that practice (Toyama, 2015).

A Suggested Role for Classroom Teachers in an IRI Classroom

Dissemination technologies like MOOCs and instructional technologies like computers or tablets in the classroom share at least one feature in common – that of the role of the teacher in guiding students through content. This role manifests itself

differently across technologies and pedagogies – at times achieved through email, online discussion forums, asynchronous chats or face-to-face interactions between teacher and student.

While MOOCs uncouple space, time and instruction, IRI attempts to uncouple pedagogy and classroom management. By using the teaching team, the classroom teacher bridges the space and time distance of the radio teacher; at the same time, the classroom teacher primarily deals with classroom and lesson management and the instructional task is primarily to be carried by the radio teacher. Taking a cue from dissemination technologies such as MOOCs, however, suggests that the need for continued guidance remains – and with the one-way communication of the radio program, that guidance role falls on the classroom teacher. This suggests that the classroom teacher does in fact *need* to do more than just classroom and lesson management.

Similarly, the TPACK framework suggests that the successful integration of an ICT in the classroom first requires productive interactions between the teacher and student – and that technology functions to amplify these quality interactions (Hoffer, 2008; Toyama, 2015). With the limitation of one-way radio, the classroom teacher then must fill this role and provide quality interactions through which the student engages with the content delivered by the radio characters.

Summary

This review of literature examined the foundation of the IRI methodology as evidenced in the mathematics and language programs in Nicaragua and Kenya, the earliest programs in which the features of the IRI programs are documented and studied. From these programs, two features of the IRI series were highlighted – the 'teaching team' of the classroom and radio teacher; and the emergence of the 'dual audience' approach.

These two features provide a backdrop for understanding the role of the classroom teacher in the *English is Fun* IRI series.

I also examined the design of the *English is Fun* IRI series for improving student's English language proficiency using the WIDA framework. I introduced the WIDA framework as a tool to restructure student's responses in the speaking assessment since the WIDA framework is commonly used in U.S. schools to guide English instruction for second language learners. To unpack teacher practice in the *English is Fun* IRI series, I examined the Teacher's Guide, prior research on teacher practice in Chhattisgarh, and the IRI scripts. These sources provided evidence of the two roles that teachers were expected to play in the IRI classroom.

I then turned to examine what the role of the classroom teacher *should* be, based on ICT research. Dissemination technologies such as MOOCs suggest that, even in a learning experience where time and space are unbundled from instruction, the guidance provided by the teacher remains important. Similarly, research on instructional technologies in classrooms, such as computers and tablets, suggests that the instructional technology interacts with the existing teacher and student interactions to either amplify interactions conducive to learning or otherwise. Both bodies of research suggest that despite the nature of the ICT and the way in which it is implemented, the role of the teacher in guiding and interacting with the student remains critical. This research suggests that in the case of IRI, despite the unbundling of time, lesson management and content, the need remains for students to interact and be guided by a teacher. The one-way communication design of IRI does not facilitate this, and in turn the classroom teacher assumes this responsibility.

In the next chapter, I apply the WIDA framework to student response data to construct three scores to measure student's English language proficiency – listening, vocabulary acquisition and sentence use. I also identify items on the Classroom Observation Tool that are aligned with what I have characterized as the primary and secondary expectations for classroom teachers in the *English is Fun* IRI series. These assessment data points provide the outcome measures of interest for my study, with the observation data providing estimates of teacher practices that are the primary independent variables of interest in my study.

Chapter 3: Methodology

The purpose of this study is to examine the impact of teachers' practices on students' learning gains for teachers and students who participated in an Interactive Radio Instruction (IRI) program in India. I examine two roles – or sets of expectations – of the IRI teacher in the *English is Fun* IRI classroom. One role characterized expectations for teachers as relatively passive, with teachers responsible primarily for setting up the technology, organizing the classroom, and following the explicit directions of the radio teacher; a second role, however, characterized expectations for teachers as more active. In this second role, teachers were encouraged to model pedagogical practices used by the radio teacher, including adjusting the lesson to students' prior knowledge and current skills. Using IRI classroom observation data from two states in India that implemented the *English is Fun* IRI series, I examine the influence of these two sets of practice on students' English proficiency. In this chapter, I outline the parameters of the study, including its design, research questions, the dataset, variables and analytic methods that I use.

Overview of Study Design

Education Development Center, Inc. (EDC) in India collected the data that I use in the study. These data come from an IRI project that was part of *Technology Tools for Teaching and Training* or T4. The flagship program of the T4 project was an IRI program, *English is Fun*, that provided English language instruction through daily, 30-minute radio broadcasts of IRI lessons for students in grades 1-4 across nine partner states. The dataset of interest for my study consists of classroom observation data of teacher practices during select IRI lessons across the academic year and student test scores prior to and following the IRI intervention. The data were collected by EDC staff and local partners for the purpose of examining the impact of *English is Fun*.

Site and Sample

Although the IRI interventions spanned multiple years, only in 2009-2010 did the project collect matched student and teacher data (i.e. teachers who were observed were also the teachers of students who were tested) in two states. As such, I limit my study to data from this particular year in the states of Delhi and Rajasthan. In both states, one IRI teacher conducted the IRI lesson in each school – and was the only teacher on whom observations were conducted. In all, the data includes 14 teachers and 214 students from Delhi, and 18 teachers and 482 students from Rajasthan. For the 32 teachers in the dataset, classroom observations during an IRI lesson were conducted between two to six times during the latter half of the academic year. For the 696 students in the dataset, pre-tests and post-tests were administered to measure students' English speaking and comprehension skills prior to and after the completion of one year of participation in the *English is Fun* intervention. Project staff also collected student demographic data, such as age, caste, and father's education.

Figure 3.1 provides a graphic representation of the study design. The circle represents the dependent variables in the design while the squares represent various independent variables or control variables. As indicated by the figure, the variables used in the study are associated with different units of analyses or levels in a hierarchical structure. The dependent variables and student demographic variables were measured at the student level, the teacher practices were measured at the teacher level, and location is measured at the school level. However, because only one teacher participated at a school, the location variable represents the state (Delhi or Rajasthan) in which teachers worked.

Next I describe each set of variables conceptually, starting with the dependent variables or student outcomes, followed by the student demographics variables and the

teacher variables, particularly the teacher practices variables. While I discuss technical aspects of these variables later in this chapter, here, I provide a rationale and general description of the major variables used in the study.

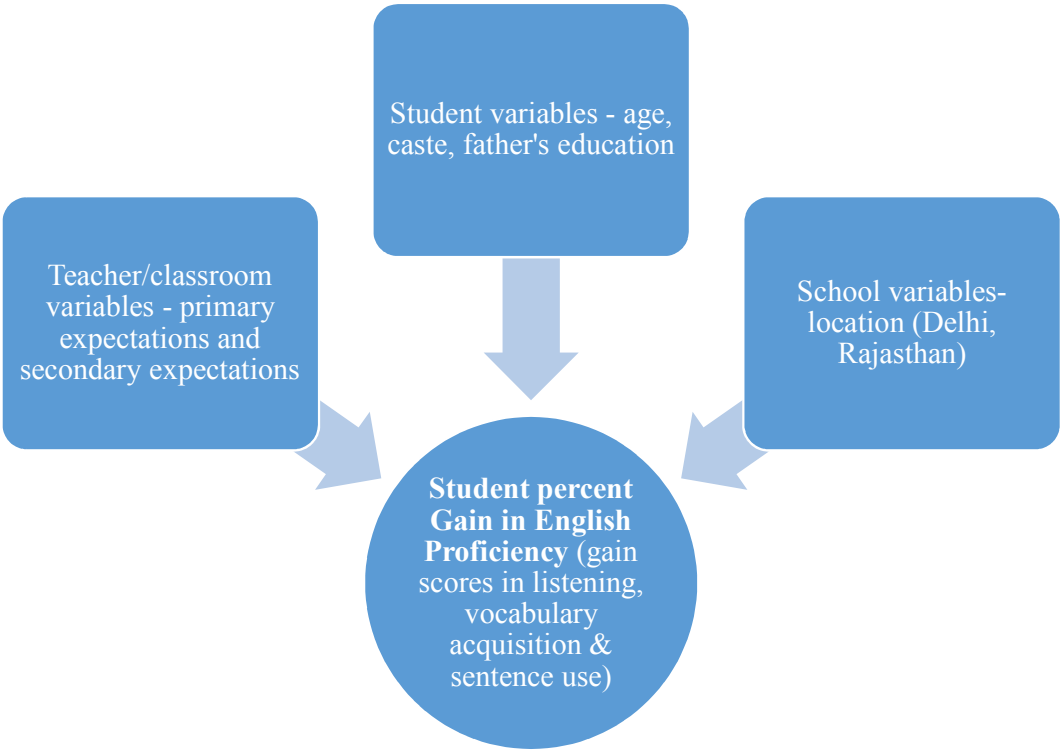


Figure 3.1 Study Design: Variable Groups affecting Student achievement in an IRI classroom

Student Outcomes: English Proficiency

Student's English proficiency level is the outcome variable of interest, as measured by the three areas of the WIDA framework relevant to the IRI design, namely listening, vocabulary acquisition and sentence use. Proficiency is calculated as the composite percent gain from pre-test to post-test on each of the three outcomes. In order to derive these scores from the dataset, items across both test forms (comprehension and speaking) were combined and the scoring framework revised to capture the nature of students' responses. Generally speaking, the comprehension test assessed students' English

listening skills while the speaking test assessed students' verbal production skills. The tools are provided for reference in Appendix 1 to 4.

An example of a comprehension item would be to ask students to point to the picture of an item on a card that corresponds to the word that the speaker states. A correct answer received a 1 while an incorrect answer received a 0 for listening. On the original speaking assessment, a student who incorrectly answered a *speaking* question received a score of 0, even if their response was correct in Hindi (i.e. they understood the question asked of them in English, but were unable to provide the correct response in English but did so in Hindi). In the revised scoring structure that I utilize for this study, this same student received a score of 1 on a 3-point scale, crediting the students' English listening ability (2 points would be rendered if they used the correct English vocabulary word(s) and 3 points if they used the correct, complete, English sentence).

Using this revised scoring structure, I estimated student ability in listening, vocabulary knowledge and use of sentences. These three sets of skills are well established in the WIDA framework, with listening and vocabulary being less complex linguistic skills and sentence use the most complex skill. While these language skills are clearly associated with each other, decomposing the comprehension and speaking assessments into three skill sets provides a more informative and detailed assessment of students' gains in English language proficiency.

Students Demographic Characteristics

Variations in student achievement can also be due to student-level factors such as the demographic characteristics of students. For example, historically in India, caste-based segregation in society is also reflected in schools and operates similar to student race as a variable that influences achievement. In an effort to provide equal access to

students of all caste groups in institutions of higher education, the Government of India guarantees admission to students of the lowest class (Other Backward Caste) equal to 25% of the in coming class. In K-12, the government of India provides additional incentives to teachers to teach in areas with predominantly OBC populations. As a result, teacher quality in practice is a function of average student characteristics such as Caste.

Moreover, the grade level of students exposed to the IRI varied by grade and across states. In Rajasthan, students in grades 1 to 4 participated in the IRI programs compared to students in grades 1 and 2 in Delhi. Although the multi-grade nature of the IRI classroom is typical of all classrooms in government schools in Delhi and Rajasthan, because learning is typically associated with age, the age of individual students and differences across classrooms in average age are potentially influential factors in students' achievement gains. Finally, gender and father's education may also influence gains in English proficiency, especially if males or females are differentially exposed to English or fathers with higher levels of education have greater access to English-speaking individuals. Because of the potential influence of these factors, they are included as controls in the multivariate multilevel models, along with caste.

Primary and Secondary Expectations of Teacher Practice

In Chapter 2, I introduced the primary and secondary sets of expectations conceptually; here, I describe how I use the classroom observation data to measure each of these sets of expectations in my study. As mentioned, the design of the *English is Fun* IRI included two potential roles or expectations for teacher practices. The first or primary set of expectations for the IRI teacher encompasses setting up the materials for the IRI lesson in the classroom and following radio instructions. The secondary set of expectations for the IRI teacher encompasses facilitation of the radio program in the classroom.

The primary expectations were explicitly stated to teachers as part of the IRI training that they received and focused on basic classroom and lesson management tasks. As such, the primary expectations of IRI teachers in Delhi and Rajasthan included setting up the IRI lesson and following directions addressed to them by the radio teacher – fulfilling their role as part of the 'teaching team'.

The secondary expectations emerge from the dual-audience approach of the IRI design used in the *English is Fun* program and were operationalized in Delhi and Rajasthan in the Classroom Observation Tool. This tool was based on prior research conducted by Royer in the state of Chhattisgarh (2006). In a study of teacher practices both during IRI and non-IRI lessons in Chhattisgarh, Royer found that IRI teachers mimicked pedagogical techniques that were modeled in the IRI lesson during their instruction of other non-IRI lessons. As a result, project staff and government officials in Delhi and Rajasthan viewed the IRI lessons as an opportunity to model positive pedagogical practices and behaviors for teachers in the hopes that they would mimic these practices.

The secondary expectations, therefore, consisted of the teacher taking a more active instructional role in the IRI lesson by mimicking the pedagogical techniques modeled by the radio characters. The extent to which Delhi and Rajasthan teachers were observed mimicking the radio characters use of pedagogical techniques (such as a group activity to practice vocabulary words or playing games to review letters and sounds, or positive and confident interactions with students) were used to measure the extent to which teachers satisfied the secondary expectations in this study. Next, I operationally define the two sets of expectations.

Primary Expectations: IRI Lesson Setup and Following Radio Instructions

The observable practices of the primary expectations are derived from the Teacher's Guide and training materials used to train teachers in Delhi and Rajasthan. These training materials and the Teacher's Guide characterize the teachers' role as largely passive and as assisting the radio teacher (comparable to what was described in the IRI literature and discussed in the previous chapter). These primary expectations are ascribed to the classroom teacher because a) they are the member of the teaching team who is physically present in the room with the students and b) they could be trained in these basic skills during the 5 days of training prior to the start of the IRI program. The primary expectations include setting up of the technology (radio), organizing the students as specified in the Teacher's Guide, as well as following instructions directed to the teacher by the radio characters during the lesson. Teachers practiced setting up, organizing a classroom, and following instructions during the five-day IRI training.

In the Classroom Observation Tool used to observe teacher practice before, during, and after an IRI lesson, the frequency of each desired behavior was observed (the tool is provided for reference in Appendix 5). The following seven items from the Classroom Observation Tool characterize the primary expectations for classroom teachers according to the Teacher's Guide and training material:

1. Students' seating arrangement is adequate.
2. Teacher distributes questions to all students.
3. Teacher is adequately able to follow instructions given by the radio characters.

4. Teacher facilitates a positive environment in the classroom.[16]
5. Teacher encourages students to respond to questions posed by IRI characters.
6. Teacher tries to keep all students engaged in IRI activities.
7. Teacher spends more time on instructional tasks than on administrative tasks during pauses.[17]

During the IRI lesson, observers took notes on teachers' practice in these seven items. Following the IRI lesson, observers rated the teacher on each item using a three-point scale ranging from never observed (1) to always observed (3) during the IRI lesson.

Secondary Expectations: Mimicking Pedagogical Techniques and Behaviors

The secondary expectations of classroom teachers included tasks that, if observed, indicated a deeper level of engagement in the IRI lesson by the classroom teacher. The assumption underlying these secondary expectations was that teachers who were observed performing these tasks were doing so as a result of mimicking what the radio characters were modeling during the course of the 120 IRI lessons. The following seven items from the Classroom Observation Tool characterize the secondary expectations:

1. Teacher facilitates the IRI lesson with confidence.[18]
2. Teacher appears comfortable managing students during group activities.

[16] According to the training manual for IRI classroom observers, the term "positive environment" indicated the absence of physical punishment to any students and the absence of negative verbal comments from the teacher to any students.
[17] According to the training manual for IRI classroom observers, instructional tasks consisted of time when the teacher was paying attention to students and the radio. Administrative tasks included time during which the teacher was grading papers (no written work was required by the IRI lessons, and therefore was considered unrelated to the IRI lesson), reading materials other than the Teacher's Guide, or absent from the classroom.
[18] According to the training manual for IRI lesson observers, teachers who facilitated the lesson with confidence used English content and pedagogical techniques during the IRI lesson without appearing to struggle and communicated with students in a confident manner.

3. Teacher facilitates IRI activities in a way that is responsive to student learning needs.[19]
4. Teacher tries to engage all students equally in each IRI activity.
5. Teacher provides additional guidance to students to help them better. understand content presented by IRI characters.[20]
6. Teacher adds his/her own 'flavor' or touch to an IRI activity to enhance student learning and enjoyment.[21]
7. During pauses, teacher asks students questions in various ways to facilitate their understanding.[22]

Again, during the IRI lesson, observers took notes on teachers' practice in these seven items. Following the IRI lesson, observers rated the teacher on each item using a three-point scale ranging from never observed (1) to always observed (3) during the IRI lesson.

[19] According to the training manual for IRI lesson observers, teachers who facilitated IRI activities in a way that was responsive to student learning needs adapted activities according to their students. Specifically, teachers may use easier or harder English content during an activity with their students, or adapt the activity itself based on their past experience with students (i.e., if they faced difficulty in conducting a similar activity in the past, then the teacher may have an alternative approach).
[20] According to the training manual for IRI lesson observers, teachers provided additional guidance to students to help them better understand content through local examples or stories, explaining terminology in the context of other vocabulary that they may have learned, or using local language to convey the meaning of the English concepts.
[21] According to the training manual for IRI lesson observers, teachers added his/her own 'flavor' or touch to an IRI activity by conducting an activity that they themselves developed or by using materials available in the classroom to demonstrate an English term or concept (e.g., showing picture cards with English words written on them; leading a conversation in English with another student or teacher; conducting hands-on activities to match letters, sounds and words or pictures of things starting with the letter).
[22] According to the training manual for IRI lesson observers, examples of questions aimed at facilitating student's understanding are: "what other words start with this letter?", "tell me the names of the parts of the body in English and in Hindi and point to that part of your body", or "I will say a word in English and I want you to explain what it means in Hindi".

Other Teacher Factors

Although there is little data about teacher characteristics other than their observed practices and little data about the actual schools in which teachers taught, location and number of observations warranted inclusion as control variables. The student populations in Delhi and Rajasthan differed, as did teachers familiarity with English. As a result I included location as a variable in the models, along with a set of interaction terms to determine if the relationship between each set of teacher practices and student gains varied as a function of location. I also included number of observations about the practices of each teacher and the number of students in each class as control variables.[23]

Research Questions and Hypotheses

Using the conceptual framework just described, this study explores two main research questions:

1. How do student English proficiency gains in listening, vocabulary, and sentence use vary significantly between classrooms/teachers who participated in the intervention?
2. How are student English proficiency gains in listening, vocabulary, and sentence use influenced by teacher practices, and, if so, which types of practices matter most?

The first question estimates a "fully unconditional model" and examines whether achievement in each outcome of interest varies between teachers or classrooms. The second research question examines whether there is a relationship between the

[23] I also adjust for sampling error in the estimate of teacher mean practices using Bayesian weights, which I discuss later in the dissertation. While the inclusion of the number of observations adjusts for differences in the amount of information about practices between teachers, the Bayesian weights adjust for potential sampling error associated with estimating the mean practice for teachers with different numbers of observations.

independent variables of interest (the extent to which the observed teacher practice satisfies the primary expectations and/or secondary expectations) and the outcome variables (English proficiency as measured by the scores for English listening, vocabulary, and sentence use) controlling for the number of classroom observations, state, and individual level differences (student gender, age, caste, and father's highest level of education).

Hypothesis 1. Students' English Proficiency Varies Significantly between Teachers

The final project report for T4 cites that average student test scores in speaking and comprehension by school (or teacher) varied (EDC, 2012). I anticipated that an analysis of the data by the WIDA framework and using a multivariate model would support the findings reported by EDC. Furthermore, I anticipated that student gains in listening would be highest, followed by vocabulary and sentence gain scores. This hypothesis was based on the relative difficulty of developing speaking skills for students learning English as a second language based on the WIDA framework. Specifically, word/vocabulary acquisition is presented as a relatively easier skill to build than is sentence-speaking skills according to the WIDA framework.

Hypothesis 2. Students' English Proficiency is Influenced by Teacher Practices

Three theoretical approaches provided the foundation for this hypothesis. First, the IRI design and the data presented in the final project report examined the correlation between the items on the teacher observation tool and student gain scores and found a positive relationship (EDC, 2012). The report cites that in both Delhi and Rajasthan students made significantly higher gains in English comprehension and speaking when

their teachers were observed demonstrating more frequent use of desirable practices. Specifically, one item from the classroom observation data in Rajasthan and four items from the classroom observation data in Delhi were found to have significant correlations with student gain scores on both tests; these items included practices associated with the primary and secondary expectations for the IRI.

Second, in a review of IRI research, Ho and Thukral (2009) examined the impact of participation in an explicit radio-based teacher professional development program in Mali and in Madagascar. Examining the IRI design from the perspective of a teacher training model, the results showed that teachers who participated in the IRI in-service teacher professional development programs adopted the pedagogical concepts and techniques explicitly demonstrated during the IRI programs; specifically, the frequency of the desired behaviors was higher among participating teachers than among non-participating teachers. While the in-service IRI series in Mali and Madagascar did not examine implicit forms of teacher professional development, as is the case with the *English is Fun* dual-audience design, it did suggest that the IRI training and lessons could influence teacher practices.

Third, a review of research on dissemination and instructional technologies suggests that, regardless of the nature of the ICT tool, the teacher's role in guiding students through content remains central to the successful implementation of an ICT. The pedagogical approaches that underlie both dissemination and instructional technologies manifested teacher practice differently, but were common in their emphasis of the need for such guidance. In the case of IRI and specifically, my hypothesis regarding the role of teacher practice in *English is Fun* classrooms, these bodies of research suggest that the classroom teacher does need to play an instructional role, above and beyond lesson

management, particularly because the radio teacher cannot provide this type of guidance through the one-way medium.

Based on the final project report, the Mali and Madagascar programs and the ICT research reviewed, I anticipated that I too will find a positive relationship between higher levels of teacher instructional practice – i.e., secondary expectations – and student outcomes. Specifically, I anticipated that teachers would set up IRI classrooms and follow instructions directed to them during the IRI program because this is what they were explicitly trained to do, as in the Mali and Madagascar programs. I also anticipated that, given the bivariate results in the T4 project report, teachers in Delhi and Rajasthan would mimic the techniques and behaviors modeled during the IRI lessons by the radio characters and that these technique would have a positive influence on student learning.

Description of Analytic Method and Measures

In this study I used both descriptive analyses and Hierarchical Multivariate Linear Modeling (HMLM) to examine the extent to which teacher practices influenced student outcomes in English proficiency. I was particularly interested in whether both sets of practices – those associated with the primary expectations and those associated with the secondary expectations – influenced student gains. While the initial designs of IRI sought to restrict the influence of the classroom teachers on instruction, the contemporary designs adopted a dual-audience design in which students might benefit from teachers taking a more active role in instruction. I used HMLM because the data structure was hierarchical (outcome measures nested within students nested within IRI classrooms) and the data included multiple outcomes (Raudenbush & Bryk, 2002; Tate & Pituch, 2007).

To test the relationship, I estimated a three-level HMLM using the HMLM-2 procedure in the statistical program HLM with level 1 as the measurement level, student demographic variables at level 2 and teacher practice and control variables at level 3.

(Note that for ease of discussion and presentation, I refer to the student level as level 1 and teacher level as level 2; I do not discuss the underlying measurement model, which includes dummy-coded variables that estimate the average gains in listening and differences in gains between listening and vocabulary and listening and sentence use as part of the multivariate model. The estimates for these intercepts are reported as part of the student and teacher models.) The outcome variables in the model were percent gains in listening, vocabulary and sentence, each of which was a continuous variable with a near-normal distribution. Independent variables were both continuous (e.g., age) and discrete (e.g., gender, students caste group, and student's father's highest level of education).

Variables

All relevant variables available on students and teachers were used in this study. I describe the outcome and predictor variables in the section below followed by a table of descriptive statistics for each variable.

Outcome Variables

The study used three student outcome variables to estimate student English proficiency levels. As I described earlier in this chapter, I recoded student responses on the comprehension and speaking assessments using the WIDA framework into three outcome variables: listening, vocabulary acquisition, and sentence use.

Because the assessment tools were somewhat different in Rajasthan and Delhi, the range of scores for each outcome also differed. After recoding the total available points in the assessment tools used in Rajasthan, there were 28 items in listening, 8 items in vocabulary, and 8 items in sentence use. The total available points in the assessment tool used in Delhi were 33 items in listening, 23 items in vocabulary, and 21 items in sentence use.

To address the differences in scales across the two states, I used percent gain scores for each of the three outcome variables (i.e., the percentage increase in correctly responses between the pre-test and the post-test), and I included interaction terms for location and teacher practices in my models. Percent gain adjusts for the differences between states in the number of items and location. Although I could have used a standardized version of the outcomes and a pre- post-model to examine how teacher practices influence each of the outcomes, I used gain scores because these scores are easier to interpret and directly measure learning. Specifically, the interaction term with teachers' practice controls for possible differential effects of teachers' practice that could be the result of location or differences in the outcome assessments.

The three outcome variables are correlated as they all measure an aspect of English language proficiency. The bivariate correlations between the three variables are provided in Table 3.1 below. These results support the use of the multivariate multilevel model for these data because the outcome measures are related. The correlations also suggest that listening and vocabulary may be more related skills than sentence use, though sentence use may be more dependent on vocabulary knowledge than listening.

Table 3.1. Relationship between Student Outcome Measures

	Listening	**Vocabulary**	**Sentence**
Listening	1.00	0.48**	0.24**
Vocabulary		1.00	0.57**
Sentence			1.00

** $p \leq 0.01$

Independent Variables

I used two sets of independent variables to examine variability in the outcome variables. Student characteristics comprised the first set of predictors and included student a) age; b) gender; c) caste; and d) father's highest level of education. Father's highest level of education was used because data were missing not at random or had limited variability

for the following variables: father's occupation, mother's highest level of education and mother's occupation. While these variables examine individual relationships with the dependent variable, they also serve as covariates at the teacher level when grand-mean centered. In other words, by including these variables grand-mean centered at level 1, the model adjusts for differences between teachers on the characteristics of their students. Teacher practice comprised the second set of predictors, and included a) the average teacher practice scores for each role or set of expectations, b) school location or state, c) number of classroom observations and d) number of students in the class.

Student-level covariates. I included four student-level predictors in the model to examine the relationship between individual characteristics and student gains and to control for differences between teachers' classrooms in student characteristics.

Age: Student age is an ordinal variable and is used to control for multi-grade classroom situations that were observed in all of the classes included in the analytic sample. Student age instead of grade level is used because student grade level does not capture the within-grade variability in student's age. The average age is seven years old with students in Rajasthan nearly a year older, on average, than students in Delhi.

Gender: Student gender is a dummy-coded variable with male=1 and female=0. The excluded (referent) group is female. There were more male students, as a percentage, in Rajasthan (50.4%) than Delhi (44.1%).

Student's Caste: Student's caste group was recorded as one of the following three categories: Scheduled Caste (SC); Scheduled Tribe (ST) or Other Backward Classes (OBC); or General Caste. A dummy-coded variable for students with missing caste data was included in the analysis (only students in Rajasthan had missing data, 8.5%). The General Caste group (12.9% in Rajasthan and 38.0 % in Delhi) was made the referent

group because it is associated with the middle of the caste hierarchy (as a referent group, it is excluded in the analytical model). In Rajasthan, approximately one third (34.7 %) of the students were classified as SC while slightly more than half (52.5%) were classified as ST or OBC; in Delhi, slightly more than a quarter (27.2%) of the students were classified as SC while a roughly equal percentage (26.2%) was classified as ST or OBC.

Father's highest education level: Fathers highest levels of education was used as a proxy for SES and home environment, including the possibility of exposure to English. Father's highest level of education was recoded as one of the following three categories: Father Illiterate, Father Literate/Primary Education, and Father Middle, High School or Higher Education. A dummy-coded variable for students with missing data was also included in the analysis (only students in Delhi had missing data, 62.4%). Father Literate/Primary Education (31.1% in Rajasthan and 16.4% in Delhi) served as the referent because it is the middle dummy-coded variable. In Rajasthan, more than one third (39.0%) of the students' fathers were illiterate whereas less than a third had obtained a middle school education or higher (29.9%); in Delhi, roughly equal percentages of students fathers were either illiterate (9.9%) or had a middle school education or higher (11.3%).

Teacher-level predictors. Teacher-level predictors are the focus of this analysis, specifically the average teacher practice score for a) the primary expectations for classroom teachers and b) the secondary expectations for the classroom teacher. I also include controls for c) location or state, number of observations for each teacher, and number of students in each teacher's classroom.

Teacher practice scores for primary and secondary expectations: As explained earlier in the chapter, these scores are based on observations of teacher actions during IRI lessons. Although teachers were observed from lesson 1 through 120, data were not

available for the first half of the IRI series. The observations that I used for this analysis came from the latter half of the 120-lesson series.[24] Using these data, I focus on the comparative influence of the extent to which teacher practice satisfies the primary and secondary expectations rather than changes in practice over time.

To calculate a teacher's score for each of the two sets of expectations, I used an approach that accounted for the variability in the number of observations between teachers, which ranged between one and six. Using HLM with observations nested within teachers, I saved the Bayesian estimate for the average score for each teacher for each item using a fully unconditional model. The average score is a weighted score that adjusts for possible sampling error (the number of observations required to estimate reliably the average score for an item for a teacher). I then averaged these adjusted scores across all items that were 'mapped' to either the primary expectations or secondary expectations for teachers during the IRI lesson.

Overall, teacher scores were somewhat higher in Rajasthan than in Delhi, with scores for the secondary expectations being higher in both states. In Rajasthan, the average scores for primary expectations and secondary expectations were 2.3 and 2.5, respectively; in Delhi, the average scores for primary expectations and secondary expectations were 2.1 and 2.3, respectively. I standardized these scores for the purpose of the analysis (M = 0, SD = 1), although mean scores on the original scale are reported in Table 3.2.[25]

School location: I represent school location with a set of dummy-coded variables for the states of Rajasthan and Delhi, where yes = 1 if students are from that state and not

[24] Of the 120 lessons of the *English is Fun* Level 1 series that students participated in, teachers in Delhi were observed during lessons 90-117 and in Rajasthan from lesson 70-111 of the same IRI series. For both states, this meant that teacher observation data represents teacher practice during the latter third of the series.
[25] The T4 final report cited 1 teacher with 1 missing score on one of the 20 items for a single observation and one teacher with 2 missing scores on two different items on a single observation.

= 0. I included the dummy-coded variable for Delhi in the analysis and used Rajasthan as the referent. Two thirds (69.4%) of the students in the study come from Rajasthan.

Number of observations: The 32 teachers included in this study were observed between one and six times each. The number of times a teacher was observed depended on whether a) the observer was able to reach the school; b) whether the broadcast was on and the radio was in working condition at the time of the broadcast; and c) whether appropriate accommodations had been made to facilitate the full broadcast. To account for this variability, I used an approach that produced a weighted mean score (described above) and included the number of observations as a control in the model. The average number of observation for teachers was comparable across locations, approximately 3-4 observations per teacher.

Number of students in the class: The number of students in the class was an important consideration in the IRI teacher training. Teachers were encouraged to implement the IRI lesson in their smaller classes, for teachers who had multiple classes. However, the average class size in Rajasthan was larger than the average class size in Delhi (26.8 and 15.3, respectively).

Table 3.2 provides descriptive statistics for all of these variables. For continuous variables, means and standard deviations are reported (SD is reported in parentheses following the mean).

Table 3.2 Descriptive Statistics – Student and Teacher Variables by State and Overall

			Rajasthan	Delhi	Total
Individual-Level Variables					
		N	482	213	695
Dependent Variables *Mean (Standard Deviation)*		*Listening Percentage Point Gain*	16.87 (25.67)	14.16 (12.61)	16.04 (22.52)
		Vocabulary Percentage Point Gain	20.20 (30.92)	14.72 (19.14)	18.52 (27.94)
		Sentences Percentage Point Gain	7.26 (16.72)	12.21 (22.90)	8.78 (18.96)
Control Variables		*Average Age*	7.25	6.29	6.96
		Percent Male	50.41	44.13	48.49
		Percent Schedule Caste (SC)	34.65	27.23	32.37
		Percent Schedule Tribe (ST)/Other Backward Caste (OBC)	52.49	26.29	44.46
		Percent General Caste	12.86	38.03	20.58
		Percent Caste Missing	.00	8.45	2.59
		Percent Father Illiterate	39.00	9.86	30.07
		Percent Father Literate/Primary Education	31.12	16.43	26.62
		Percent Father Middle, High School or Greater	29.88	11.27	24.17
		Percent Father Education Missing	.00	62.44	19.14
Group-Level Variables					
		N	18	14	32
Independent Variables (Mean Score)	*Avg. Class Obs. Score (1-3):*	*Primary Expectations*	2.34 (0.29)	2.14 (0.28)	2.25 (0.30)
		Secondary Expectations	2.51 (0.30)	2.28 (0.30)	2.41 (0.30)
Control Variables		*Average Number of Observations*	3.61	3.79	3.69
		Average Number of Students per Teacher	26.78	15.29	21.75

Note: Independent Variables at the Teacher Level are standardized in subsequent tables and in the HMLM models discussed.

Analytic Sample

In Delhi, the project staff collected student achievement data from 5,292 students in grades 1 and 2 in 203 schools (spread over three of eight zones in the city). In Rajasthan, the project staff collected student achievement data from 5,250 students in grades 1 through 4 in 240 schools. Of these students, a smaller subsample of students for whom teacher data were available were included in the study. Based on these criteria, the analytic sample for the study was 696 students and 32 teachers from Delhi and Rajasthan.

This sample of classrooms satisfied the following criteria: first, the classroom had the necessary resources to conduct the IRI lesson (electricity, adequate space, assigned teacher, radio, adequate reception of the broadcast); second, the observer was able to reach the school on a regular basis without significant lapses; and third, that the class continued to meet throughout the implementation period (the teacher was not reassigned nor the reception found to be inadequate, or appropriate accommodations for IRI were consistently made throughout the year for the full broadcast). The analytic sample for this study included the following student data, by grade and by state:

Table 3.3 Analytic Sample - Students by State

		Rajasthan	*Delhi*	*Total*
Grade	1	127	101	228
	2	135	113	248
	3	114	0	114
	4	106	0	106
	Total	**482**	**214**	**696**

Observations of teacher practice were conducted for 17 teachers in Delhi, of whom 14 teachers were matched to student achievement results (note that the T4 project report cited that observers were trained prior to the start of observations, and observation data was monitored for inconsistences; however, inter-rater reliability (IRR) statistics were not reported). In Rajasthan, 18 teachers were observed and matched to student achievement results. In both states, teachers were observed during a complete instructional period,

which included pre-broadcast activities, the IRI lesson (which lasted 30 minutes of the 45 minutes allotted for English), and post-broadcast activities. However, given the inconsistencies in the observations before and after lessons, I use only the observations during the IRI lesson.

The observations that are included in the current analysis span the latter portion of the IRI series when teachers were receiving no other face-to-face support. Of the 120 lessons of the *English is Fun* Level 1 series that students participated in, teachers in Delhi were observed during lessons 90 to 117 and in Rajasthan during lesson 70 to 111 of the same IRI series. For both states, this meant that teacher observation data represented teacher practice during the latter half of the series. According to the project report (EDC, 2012), the purpose for observing teachers during this latter portion of the academic cycle was to inform areas of need for the next academic cycle. Across both states, the number of observations per teacher for which data were available ranged between 1 and 6 as shown in Table 3.4 below.

Table 3.4 Analytic Sample - Number of Teachers with 1-6 Observations

	Number of observations					
	1 obs.	**2 obs.**	**3 obs.**	**4 obs.**	**5 obs.**	**6 obs.**
Delhi	1	2	0	7	4	0
Rajasthan	4	2	3	2	2	5
Total	5	4	3	9	6	5

By state, 14 teachers in Delhi were observed during instructional periods in which students of grades 1 and 2 were in their classrooms, and 18 teachers in Rajasthan were observed in which students of grades 1 to 5 were in their classrooms (Table 3.5). Although students in both grades 1-2 in Delhi were tested and included in the student data, Grade 5 students in Rajasthan (although they were in the IRI classroom) were not tested and thus were not included in the dataset for this study.

Table 3.5 Analytic Sample - Teachers by State and Grade

	Grades Taught		
	Gr 1-2	**Gr 1-5**	**Total**
Delhi	14	0	14
Rajasthan	0	18	18
Total	**14**	**18**	**32**

Summary

The purpose of this study was to examine the extent to which Interactive Radio Instruction (IRI) teachers' practices influence their students' English proficiency gain scores. Using the conceptual framework of the IRI design, I mapped the observation items for the *English is Fun* IRI series onto either primary or secondary expectations of the classroom teacher. In turn, I examined the impact of each set of expectations on students' gain scores in English listening, vocabulary, and sentences using a multilevel multivariate model. This chapter addressed the methodology and methods that I used in the multilevel study to ascertain how teacher practice in an IRI classroom influences student outcomes.

Chapter 4: Results

In this chapter I present the results of the statistical analyses conducted to examine the relationship between teacher practices in an Interactive Radio Instruction (IRI) classroom and students' English proficiency levels, using data from two states in India – Delhi and Rajasthan. The results presented below are from two multivariate, multilevel models (HMLM) intended to examine my research questions:

1. How do student English proficiency gains in listening, vocabulary and sentence use vary significantly between classrooms/teachers who participated in the intervention?
2. How are student English proficiency gains in listening, vocabulary and sentence use influenced by teacher practices, and, if so, which types of practices matter most?

Although the primary focus of the study is the second research question, examining the first research question is a necessary step in building the hierarchical model. The first research question also provides a context by which to understand the second research question: namely, what gains did students make in listening, vocabulary and sentence use, and how do average gains in each of the scale sets vary among the teachers' classrooms in the study?

In the first series of statistical models, I explore the empty or the null model to address research question one. This model partitions the variance in the dependent variables within and among classrooms and provides an estimate for how much of the variance in the dependent variables might be explained by the characteristics of the classrooms in which students are grouped. The null model also provides an estimate of

mean gains for each of the dependent variables across all of the classrooms. The mean gains, along with the variance associated with each, provide an initial indicator of whether teacher practices may influence listening, vocabulary acquisition and sentence usage outcomes differently.

My second set of analyses address the second research question – that is, the relationships between expected teacher practice and students' proficiency levels in English listening, vocabulary acquisition and sentence use. The two sets of expectations for IRI teachers are based on the design of the IRI teacher training (primary expectations) and on prior research and the design of the *English is Fun* IRI series (secondary expectations). The measures used to estimate average teacher practice in this study are weighted aggregates of the relevant items from the Classroom Observation Tool averaged across time. Items included in the primary expectations (e.g., setting up the IRI classroom, organizing students and following directions from radio characters) include items for which teachers received explicit training prior to the start of the IRI series; items included in the secondary expectations (e.g., mimicking pedagogical techniques and behaviors described by the radio characters) include items for which teachers received support, implicitly, through modeling of pedagogical techniques across the IRI series.

For each set of analyses, I examine a) a fully conditional model that includes all variables of interest, as well as b) a final parsimonious model that retains only statistically significant variables for purposes of interpretation. Differences between the full and parsimonious models can help to identify potentially spurious relationships resulting from model specification. The final parsimonious model estimates the influence of average teacher practice on the average students' English proficiency level in listening, vocabulary acquisition and sentence use.

The three outcome variables are entered into the model as a percent gain score from baseline (prior to the start of the IRI program) to endline (at the end of one academic cycle of the IRI program). The gain score is used because the distribution of scores abides by the normality assumption for hierarchical modeling and similar linear models; baseline and endline scores for each of the three outcome variables are somewhat skewed and not normally distributed. Moreover, the gain scores directly measure learning whereas a status model, modeling endline scores while controlling for baselines scores, models learning indirectly.

In the multivariate model for this study there are three dependent variables: gains in listening, gains in vocabulary and gains in sentence use. To distinguish each outcome, I include indicator or dummy-coded variables at the measurement level or level 1 of the model. The model has three distinct intercepts that can be modeled as a function of student and teacher characteristics or variables (as opposed to a hierarchical model with a single outcome variable and a single intercept). The first intercept represents the average gain score made by IRI students on the omitted indicator variable – listening. The next two intercepts represent the difference in average gains in vocabulary versus listening and sentence use versus listening, respectively. If the estimate for an intercept is not statistically significant, the estimate for the intercept is essentially zero. For example, if the intercept for vocabulary is not statistically significant, there is no difference in the amount of gain made by students in listening and vocabulary – gains (or losses) are equal in these two areas. By setting the model up in this way, the relative influence of teachers' practice on each of the outcomes can be compared simultaneously.

Continuous independent variables – teacher's observation scores for the primary and secondary expectations – were *z*-standardized scores ($M = 0$; $SD = 1$). As a result, coefficients can be interpreted as the percentage point change in the dependent variables

associated with a standard deviation change in teacher practice. Categorical independent variables are indicators or dummy-coded variables. The referent group for each set of dummy-coded variables is identified with a footnote at the bottom of each table. All level-1 variables are grand-mean centered in both the full model and the parsimonious model, such that the estimates of the level-2 coefficients are interpreted as the average teacher effect on the average dependent variable controlling for differences in student characteristics across classrooms (Ma, Ma, & Bradley, 2008).

Because the number of observations varied across the classrooms, teacher's observation scores were calculated as the Bayesian-weighted score from a series of multilevel regressions on the available observation for each teacher (teachers received between 1 and 6 observations). The Bayesian-weighted average scores adjust for the reliability of each estimated average score for each observed practice, which is a function of the number of observations for a given teacher and the extent to which observation scores varied among teachers. Generally speaking, the reliability of an estimate of an average score for a teacher increases when a) there are more observations that can be used to estimate the average and b) average scores vary more among teachers. As such, the observation scores used in the hierarchical model represent a teacher's average score, adjusted for the reliability of the pooled observations on which the teacher's average score is based. I also include a measure of the number of observations for each teacher at level 2 of the model, to further control for the fact that I have more information about the practices of some teachers than others. Taken together, these two approaches account for the reliability of estimates for the average teacher score across observations and the difference in the number of observations for each teacher.

As with the level-1 variables, categorical variables at level 2 were also dummy coded and the referent group identified with a footnote at the bottom of the tables.

Interaction terms at level 2, specifically between the state in which the classroom resides (Delhi or Rajasthan) and each of the two sets of expectations for teacher practices, were also included in the model. Wherever interaction terms were statistically significant, all of the variables included in the interaction term were also retained in the parsimonious model. I used this same strategy for sets of dummy-coded variables, including the indicator variables that I used for variables that have missing data.

To estimate the multilevel, multivariate model, I used the HMLM2 module of the statistical package HLM 7.01. The multivariate model has several advantages over the multilevel model, where each outcome is modeled independently. First, the multivariate model allows for modeling simultaneously three potentially correlated or related independent variables. If modeled separately, the relationships between listening, vocabulary and sentence gains would not be factored into the results. Second, by modeling all three dependent variables simultaneously, it is possible to determine whether each set of expectations for teachers (primary or secondary expectations in this case) has the same or a different relationship with each of the dependent variables (gains in listening compared to gains in vocabulary or gain in listening compared to gains in sentence use). When two or more dependent variables are believed to be related (statistically and conceptually), the multivariate, multilevel model is statistically more powerful and informative than a set of multilevel models that examines the dependent variables separately (Snijders and Bosker, 2000).

In the HLM 7.01 software, the 2-level multivariate version of the multilevel model is, in fact, a three-level model. The measurements are at level 1 (i.e., the estimates for average gains in listening, the difference between average gains in listening and average gains in vocabulary and the difference between average gains in listening and average gains in sentence use), the student characteristics are at level 2 and teacher characteristics

are at level 3. In this paper, I refer to level 1 as the student level and level 2 as the teacher level; I do not refer explicitly to the underlying measurement model. A benefit of this multivariate multilevel model, particularly for analyses of small sample sizes, is that it increases the statistical power because the measurement model expands the number of data points (three proficiency scores per student, in this case) and adjusts for potential error associated with the relationship between the three dependent variables.

This chapter presents the results obtained for the two teacher-level variables and their interactions with state (Delhi is used as the dummy-coded variable with Rajasthan as the excluded variable). The results are presented according to the research questions stated at the beginning of this chapter, beginning with the fully unconditional model to address research question one followed by the full and parsimonious models to address question two. I summarize my hypotheses for each research question, discuss the results, compare the relative influence of teachers' practice on students' English proficiency levels and examine how these results answer the research questions at hand. The chapter concludes with a brief summary of findings that are further elaborated in Chapter 5.

Fully Unconditional Univariate Models

The fully unconditional model is used to estimate the intercepts and the variance in a dependent variable associated with different levels of a hierarchical structure. In the current study, the estimate for the average gains across classrooms and the variance between classrooms for the dependent variables is of interest in research question one. To establish the parameters and appropriateness of the hierarchical approach for modeling the data, each outcome variable was independently modeled in an HLM analysis to calculate the average gains and intra-class correlation coefficient, or ICC. The fully unconditional models for each of the three outcome variables are represented as follows:

Listening

Level 1: $Listening\ Gain_{ij} = \beta_{0j}$

Level 2: $\beta_{0j} = \gamma_{00} + v_{0j}$

Vocabulary

Level 1: $Vocabulary\ Gain_{ij} = \beta_{0j}$

Level 2: $\beta_{0j} = \gamma_{00} + v_{0j}$

Sentence

Level 1: $Sentence\ Gain_{ij} = \beta_{0j}$

Level 2: $\beta_{0j} = \gamma_{00} + v_{0j}$

where γ_{00} represents the average gain score on each of the three dimensions of English proficiency, with no predictors in the model at either level. The results of these three models provide the proportion of the total variance that resides between classrooms, reported as τ_{00} in Table 4.1. Table 4.1 also presents the reliability, intra-class correlation coefficient (ICC) and the within-teacher variance (σ^2) for each of the three dependent variables.

For each variable, the ICC indicates that approximately one third of the variance in student gain scores lies between classrooms – specifically, 31%, 33%, and 38% of the variability in listening gains, vocabulary gains and sentence gains, respectively.

Table 4.1. Fully Unconditional Univariate Models - ICC and Variance Components

Dependent variable	Reliability	ICC	σ^2 (variance within classrooms)	τ_{00} (variance between classrooms)
Listening Gains	0.90	0.31	341.70	154.11
Vocabulary Gains	0.91	0.33	484.66	241.54
Sentence Gains	0.92	0.38	231.00	143.41

Note: Results reported here are based on a two-level HLM model with single outcome measures. Intra-Class Correlations (ICC) is calculated as $\tau_{00}/(\tau_{00}+\sigma^2)$.

Based on the results of the fully unconditional models, English proficiency scores in listening, vocabulary and sentence speaking vary both between and within teachers' classrooms, with approximately two thirds of variability in scores residing within teachers' classrooms. Of interest for this analysis, and as the foundation for continuing with a multilevel analysis of the data, is the proportion of variability that exists between classrooms. The listening, vocabulary and sentence gains for students in IRI classrooms varies significantly between classrooms and can be subject to further examination with the addition of level-2 (classroom level) variables.

Average gain scores in each skill area are reported also in Table 4.2 based on the results of the fully unconditional model. The magnitude of the change in students test scores in sentence speaking was smaller than the magnitude of change in students test scores in listening and vocabulary speaking, as anticipated given that speaking in sentences is a more difficult linguistic task than either listening or the acquisition of vocabulary. However, there are also noticeable differences in gains between states, suggesting that the inclusion of state in the multivariate, multilevel models is warranted. Comparing Delhi and Rajasthan, students in Rajasthan made larger gains in listening and vocabulary than did students in Delhi; the opposite was true with gains in sentence speaking. Overall, the highest gain scores for students in both states were observed in vocabulary speaking.

In listening, the average gain was 15.7 percentage points across states, while in Delhi the average listening gain score was 14.1 percentage points and in Rajasthan 16.9 percentage points. In vocabulary, the average gain score was 17.3 percentage points, whereas in Delhi the average gain score was 14.5 percentage points and in Rajasthan 19.4 percentage points. In sentence speaking, the average gain score was 8.8 percentage points,

while in Delhi the average gain score was 11.4 percentage points and in Rajasthan 6.8 percentage points.

Table 4.2. Mean Gain Scores by Skill – Overall and by State

Dependent variable	Overall gain (both states)	Delhi	Rajasthan
Listening Gains	15.7	14.1	16.9
Vocabulary Gains	17.3	14.5	19.4
Sentence Gains	8.8	11.4	6.8

In summary, students made gains in listening, vocabulary and sentence speaking, with the largest gains in vocabulary followed by gains in listening and sentence speaking. The patterns of gains varied by state, indicating that state may have a direct effect on the outcomes, a possible moderating effect with teacher practices, or both. The variance in gains for each of the dependent variables warrants the use of multilevel modeling, with as much as one third of the variance in gains that could be explained by teacher practices.

Within-Teacher Classroom Multivariate Models

Based on the results of the fully unconditional model, the next step is to construct a within-teacher classroom model that specifies level-1 variables for student demographics with no variables at level 2. This within-teacher classroom model examines the relationship between student demographics and the three outcome variables for English proficiency. In the following within-teacher classroom model, the unit of analysis is the individual student and the variables of interest include age, gender, caste and father's highest level of education. I also include dummy-coded variables for students with missing data about caste and father's education, so as to estimate potential bias in missing data. If the coefficient for the dummy-coded variable for students with missing data is statistically significant, students with missing data differ from students with data, indicating that

missing data for a particular variable may present a bias. Table 4.3 presents the within-teacher classroom full model (which includes all variables of interest) and the parsimonious model (which includes all statistically significant variables of interest). The level-1 (within-teacher classroom) models for each of the three outcome variables are represented as follows:

Listening

Level 1: $Listening\ Gain_{ij} = \beta_{0j} + \beta_{qj}(student\ demographics) + r_{ij}$

Vocabulary

Level 1: $Vocabulary\ Gain_{ij} = \beta_{0j} + \beta_{qj}(student\ demographics) + r_{ij}$

Sentence

Level 1: $Sentence\ Gain_{ij} = \beta_{0j} + \beta_{qj}(student\ demographics) + r_{ij}$

In the two within-teacher classrooms models (full and parsimonious), all variables are grand-mean centered and only the intercept associated with each dependent variable has a random effect. Results for the full model are presented in the first column of Table 4.3; with results for the parsimonious model presented in the second column. The results presented in Table 4.3 can also be organized as the results for each of the dependent variables – listening, vocabulary and speaking. I refer to these sub-models as panels when reporting the results, focusing mainly on the results reported by the parsimonious models. Although the coefficients for vocabulary gains and sentence gains represent the difference in gains for students in these areas compared to their listening gains, the coefficients can also be interpreted more generally as their direct influence on students' vocabulary gains and sentence gains. For ease of interpretation, I have calculated the point estimates for students' gains in each of the three skill areas using the coefficients.

The first panel of Table 4.3 represents the average gains in listening. The coefficient for the intercept indicates that that average listening gain for IRI students was 14.4 percentage points, for the student with average age. In general, older students gained more in listening than younger students. On average, for every year increase in a child's age, their listening gain increased by an additional 3.0 percentage points. In other words, a student who was 8 years old (or, one year older than the average age of 7), had an average gain score of 17.4 in listening (14.4 + 3.0). There were no differences in listening gains between male and female students, between students from different castes or between students with fathers who had different levels of education.

The second panel of Table 4.3 represents the average difference between a student's vocabulary gain scores and listening gain scores. The coefficient for the intercept indicates that, for a student in the General Caste group, of average age, their gains in vocabulary were 2.5 percentage points higher than their gains in listening. Using the coefficients to calculate a point estimate, students in the General Caste group had an average gain score of 16.9 percentage points in vocabulary acquisition (14.4 + 2.5). Once again older students had greater gains in vocabulary than younger students. For every one-year increase in a child's age, the difference in gain score was an additional 1.95 percentage points. In other words, 8 year-old students in the General Caste group, on average, had vocabulary gains of 21.9 percentage points (14.4 + 3.0 + 2.5 +2.0).

Unlike with listening, specific caste groups also had greater gains in vocabulary compared to other caste groups. Students in the Schedule Tribe (ST) or Other Backward Caste (OBC) group gained 13.0 fewer percentage points in vocabulary compared to all other caste groups. When combined with the intercepts for listening and vocabulary to calculate a point estimate, the model estimates that students in the ST/OBC castes gained

3.9 percentages points in vocabulary (14.4 + 2.5 – 13.0). No statistically significant differences were observed for father's highest level of education.

The third panel of Table 4.3 represents the average difference between a student's speaking gain scores and listening gain scores. The coefficient for the intercept indicates that, for a student in the General Caste group and whose father's highest level of education is literate or primary education, their gains in sentence were 7.3 percentage points *lower* than their gains in listening. Once again, using the coefficients to calculate a point estimate, students in the General Caste group and whose father's highest level of education is literate or primary education had an average gain score of 7.1 percentage points in sentence use (14.4 – 7.3). There were no statistically significant differences by age.

However, there were differences in gains between students from different castes, between students whose father's had different levels of education and between students with and without missing data about father's education. Students in the ST/OBC castes had fewer gains in sentence use, -5.0 percentage points, compared to all other caste groups, as did students with illiterate fathers, -6.6 percentage points, compared to students whose fathers were more educated. Students without data about their fathers' education had higher levels of sentence gain, 6.7 percentage points, compared to students whose fathers who were literate or had higher levels of education. When combined with the intercepts for listening and sentence use, students in the ST/OBC castes gained 2.2 percentage points in sentence use (14.4 – 7.3 – 4.9), students with illiterate fathers gained 0.5 percentage points in sentence use (14.4 – 7.3 – 6.6), and students with missing data about their father's education gained 13.6 percentage points in sentence use (14.4 – 7.3 + 6.5).

Overall, older students made greater gains in listening and vocabulary than younger students, though age did not have an influence on gains in sentence use. Moreover, vocabulary gains were greater compared to listening and sentence use for most students. ST/OBC students, however, made greater gains in listening than in vocabulary (3.9 percentage points v. 14.4 percentage points). These students, along with students whose fathers were illiterate, also had substantially smaller gains in sentence use than other students (2.2 percentage points and 0.5 percentage points, respectively v. 7.1 percentage points). However, because the missing data variable for father's education was statistically significant, some caution is warranted in interpreting the effects father's education on sentence gains. The coefficient for illiteracy may over or under estimate the influence of father's education on sentence gains depending on the actual education level of the fathers of students with missing data.

Table 4.3. Within Teacher Classroom Multivariate Multilevel Model

	Full Model	*Parsimonious Model*
Listening Intercept		
Intercept	14.40*	14.38*
Age	2.79*	2.95*
Male	-0.58	
Schedule Caste (SC)	1.08	
Schedule Tribe (ST) or Other Backward Caste (OBC)	-2.05	
General Caste (referent group)		
Caste Missing	-0.68	
Father Illiterate	2.35	
Father Literate or Primary Education (referent group)		
Father Middle, High School or Graduate	0.28	
Father Education Missing	-0.09	
Vocabulary Intercept		
Intercept	2.48*	2.48*
Age	2.37*	1.95*
Male	2.47	
Schedule Caste (SC)	0.81	1.23
Schedule Tribe (ST) or Other Backward Caste (OBC)	-14.44*	-12.96*
General Caste (referent group)		
Caste Missing	06.15	-6.99
Father Illiterate	-0.37	
Father Literate or Primary Education (referent group)		
Father Middle, High School or Graduate	1.00	
Father Education Missing	-3.52	
Sentence Intercept		
Intercept	-7.26*	-7.26*
Age	0.87	
Male	2.06	
Schedule Caste (SC)	0.47	1.15
Schedule Tribe (ST) or Other Backward Caste (OBC)	-5.13*	-4.94*
General Caste (referent group)		
Caste Missing	-2.32	-4.32
Father Illiterate	-8.12*	-6.63*
Father Literate or Primary Education (referent group)		
Father Middle, High School or Graduate	-1.14	-1.38
Father Education Missing	4.27	6.56*

*Note: * Significant at the 0.10 level; ** significant at the 0.05 level. The referent group is excluded from the model and is thus the group for whom the intercept is interpreted. The vocabulary and sentence intercept panels represent the difference in gains as compared to the listening gains in the first panel of the table.*

Between-Teacher Classroom Multivariate Models

Building on the parsimonious within-teacher classroom multivariate model, the next step was to include level-2 variables of interest (i.e. at the classroom or teacher level, which, in my study, is one classroom/teacher per school).[26] The between-teacher classroom model helps determine whether there is a relationship between teachers practice (or the extent to which the classroom teacher fulfilled the primary and secondary expectations) and students' English proficiency levels, after controlling for differences between classrooms in children's demographics. The level 2 (between-teacher classroom) models for each of the three outcome variables are represented as follows:

Listening

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{1j}(primary\ expectations) +$
$\gamma_{2j}(secondary\ expectations) + \gamma_{qj}(control\ variables) + v_{0j}$

Vocabulary

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{1j}(primary\ expectations) +$
$\gamma_{2j}(secondary\ expectations) + \gamma_{qj}(control\ variables) + v_{0j}$

Sentence

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{1j}(primary\ expectations) +$
$\gamma_{2j}(secondary\ expectations) + \gamma_{qj}(control\ variables) + v_{0j}$

As with the within-teacher classroom model, two models were specified – one fully conditional model (which included all level-2 variables of interest) and a parsimonious model (which retained only the statistically significant level-2 variables). In the models, I grand-mean centered the two continuous variables (number of students and

[26] The between-teacher classrooms model is in fact between-schools; but with one classroom per school.

number of observations) and leave un-centered the teacher practice variables (average scores on the primary expectations and secondary expectations), a dummy-coded variable for state (Rajasthan is excluded as the referent group) and the interaction terms between state and the two teacher practice variables. The parsimonious model is discussed below while results for both are presented in Table 4.4.

The first panel of Table 4.4 represents the average gains in listening, controlling for difference between classrooms in student characteristics, number of observations, class size and teacher practices. The coefficient for the intercept indicates that the average listening gain for a typical student was 12.5 percentage points. There were no statistically significant differences between teachers who had more or fewer observations or more or fewer students. There was also no difference in listening gains between students who participated in a classroom in Delhi and students who participated in a classroom in Rajasthan, when teacher practices were equal.

Although the interaction terms indicate that neither the primary nor the secondary expectations for teachers were associated with listening gains in Rajasthan, they were associated with listening gains in Delhi. For every one standard deviation increase in a teacher's average score on the primary expectations, their students' listening gain score was 20.2 percentage points *lower* than the teacher with average practice in the primary expectations. For every one standard deviation increase in a teacher's average score on the secondary expectations, their students' listening gain score was 18.6 percentage points *higher* than the teacher with average practice in the primary expectations. Hereafter, teacher's average scores – representing average teacher practice on each expectation scale across the second half of the IRI series – are referred to as teacher's scores for brevity.

These coefficients can be used to calculate point estimates to facilitate interpretation. For example, a student in Rajasthan whose teacher scored higher on the

primary expectations than other teachers had practically no listening gains (12.5 +3.9 – 20.2= -3.8), whereas a student in Delhi whose teacher scored higher on the secondary expectations gained on average 33.8 percentage points (12.5 + 3.9 – 1.2 +18.6). These results suggest that while teacher practice in the primary expectations mattered in improving listening gains in Delhi, it did not matter in Rajasthan; all students in Rajasthan gained 12.5 percentage points in listening, regardless of their teacher's observed practices. For students in Delhi, however, when teacher's practice scores were higher than or lower than other teachers, their practices made a difference.

The second panel of Table 4.4 represents the average difference between a students' vocabulary gain scores and listening gain scores, controlling for differences between classrooms in student characteristics, number of observations, class size and teacher practices. Under these conditions, and unlike the within-teacher classroom model, there was no difference in the average gains made in vocabulary compared to listening. Nonetheless, for every additional observation visit received by the teacher, students made 1.3 percentage points greater gains in vocabulary than in listening. Similarly, for every additional student in the classroom, the average vocabulary gain score increased by 0.4 percentage points.

Although the indicator for state and the interaction terms were not statistically significant for gains in vocabulary acquisition, there was a direct effect of teacher practices, which generally followed the same pattern of effect as the model for listening gains in Delhi. Specifically, for every one standard deviation increase in a teacher's score in the primary expectations in both Rajasthan and Delhi, their students' vocabulary gain scores were 9.3 percentage points *lower* than in listening; for every one standard deviation increase in a teacher's score in the secondary expectations, their students' vocabulary gain scores were 6.8 percentage points *higher* in vocabulary than in listening.

Again, we can use the coefficients in the parsimonious model to calculate point estimates for the total vocabulary gains for students whose teachers emphasized different practices. A student in Rajasthan or Delhi whose teacher scored higher on the primary expectations than other teachers gained an average 3.2 percentage points in vocabulary (12.5 – 9.3), whereas a student in Rajasthan or Delhi whose teacher scored higher on the secondary expectations gained an average 19.3 percentage points (12.5 + 6.8). These data suggest that teacher practice in the secondary expectations mattered in improving vocabulary gains for students in both Delhi and Rajasthan

The third panel of Table 4.4 represents the average difference between a student's sentence gain scores and listening gain scores, controlling for differences between classrooms in student characteristics, number of observations, class size and teacher practices. Under these conditions, the average gain in sentence use was 7.1 percentage points *lower* than the average gain in listening. There were no statistically significant differences for the parsimonious model between teachers who had more or fewer observations or more or fewer students. There was also no difference in sentence gains associated with the indicator for state or any of the interaction terms.

Once again there was a direct effect of teacher practice that followed the pattern for vocabulary gains and the pattern for listening gains – such that when teachers more frequently demonstrated behaviors classified as a primary expectation, student gain scores were lower than in classrooms where teachers did not demonstrate these behaviors frequently; the opposite held true for secondary expectations. Specifically, for every one standard deviation increase in a teacher's score in the primary expectations in both Delhi and Rajasthan, their students' sentence gain scores were 10.9 percentage points *lower* than in listening; for every one standard deviation increase in a teacher's score in the secondary

expectations, their students' sentence gain scores were 6.3 percentage points *higher* than in listening.

Using the coefficients to calculate point estimates, a student in Rajasthan or Delhi whose teacher scored higher on the primary expectations than other teachers actually had an average *negative* gain of 5.5 percentage points (12.5 – 7.1 – 10.9), whereas a student in Rajasthan or Delhi whose teacher scored higher on the secondary expectations than other teachers had a positive gain of 11.7 percentage points (12.5 – 7.1 + 6.3). As with vocabulary gains, teacher practice in the secondary expectations mattered more in improving students' gain scores in sentence use.

In general, teacher practices had the same association with English proficiency gains for all three forms of proficiency, though for listening gains the pattern was evident only in Delhi. Students in classrooms where teachers were observed to have the highest levels of compliance with the primary expectations (e.g., setting up the classroom, turning on the radio, following the radio instructor's directions) had the lowest gains in listening, vocabulary and sentence use; students in classrooms where teachers were observed to have greater levels of activity associated with the secondary expectations (e.g., interacting with students with confidence, adding to the IRI content, facilitating activities) had the highest gains in listening, vocabulary and sentence use. Number of observations and class size were statistically significant predictors of proficiency gains only for vocabulary.

Table 4.4. Between-Teacher Classroom Multivariate Multilevel Model

	Full Model [27]	*Parsimonious Model*
Listening Intercept		
Intercept	10.66*	12.52**
Delhi	7.32	3.86
Number of Observations	0.74	
Number of Students per Teacher	0.38	
Std. Observation Score – Primary Expectations	5.59	3.92
Std. Observation Score – Secondary Expectations	-2.34	-1.18
Interaction: Primary Expectations x Delhi	-19.19*	-20.22**
Interaction: Secondary Expectations x Delhi	15.96	18.58*
Vocabulary Intercept		
Intercept	0.43	1.18
Delhi	0.11	
Number of Observations	1.55*	1.25**
Number of Students per Teacher	0.50*	0.40**
Std. Observation Score – Primary Expectations	-7.54*	-9.28**
Std. Observation Score – Secondary Expectations	6.30*	6.78**
Interaction: Primary Expectations x Delhi	-3.03	
Interaction: Secondary Expectations x Delhi	-0.40	
Sentence Intercept		
Intercept	-9.41*	-7.14**
Delhi	4.10	
Number of Observations	1.00*	0.57
Number of Students per Teacher	0.20	
Std. Observation Score – Primary Expectations	-7.84*	-10.90**
Std. Observation Score – Secondary Expectations	4.88*	6.27**
Interaction: Primary Expectations x Delhi	-8.81	
Interaction: Secondary Expectations x Delhi	5.31	

*Note: * Significant at the 0.10 level; ** significant at the 0.05 level*

[27] The level 2 Full Model utilizes the parsimonious level 1 model.

Summary

The results of the analyses suggest that students who participated in the IRI program in Rajasthan and Delhi had the greatest gains in listening and vocabulary but smaller gains in sentence use. These gains varied substantially across teachers' classrooms and could be explained, in part, by differences in student characteristics between classrooms, number of teacher observations, class size and teacher practices, the latter of which was most important in this study. Although I anticipated that both the primary expectations and the secondary expectations for the IRI program would have a positive relationship with English proficiency gains, this was not the case for gains in sentence use. In both states, higher levels of teacher practice in the primary expectations were negatively associated with gains in sentence use and with small but positive gains in listening and vocabulary, while higher levels of teacher practices in the secondary expectations were positively associated with gains in all three skill areas. Teachers' practices clearly mattered but not in the way that I anticipated for each skill that IRI students in Delhi and Rajasthan were tested in. I interpret and discuss these results in the final chapter.

Chapter 5: Discussion

Does the extent to which an IRI teacher satisfies the primary and secondary expectations influence their students' English language proficiency? If so, which types of practices matter most? These overarching questions have guided the analyses in this dissertation. The multilevel analyses of students' English language proficiency and teachers' practices in an Interactive Radio Instruction (IRI) classroom were conducted on measures of students' performance in English listening skills, vocabulary acquisition and sentence. Of most interest in this study is the extent to which teachers' practice in primary expectations (setting up the IRI classroom, organizing students and following directions from radio characters) and secondary expectations (modeling pedagogies and facilitating learning beyond the instructions) influence learning gains. I find evidence that teachers' practices in both expectations matter, but that practice in the secondary expectations may actually matter more.

In this chapter, I discuss and interpret the study's major findings from Chapter 4 as they relate to each of the two research questions and the hypotheses. This chapter also discusses to what extent the results align with extant literature and how the findings potentially inform both IRI program design and implementation in Delhi, Rajasthan and other states in India, where the *English is Fun* IRI program is being used. Finally the chapter acknowledges the study's limitations and provides an assessment of how future research can contribute to the literature on IRI programs. Unless otherwise stated, findings discussed pertain to those from the study's parsimonious models presented in the previous chapter.

Review of the Problem

The *English is Fun* IRI series was targeted at improving students' English proficiency in six states in India in alignment with national policies to expand access to English instruction for students where teacher instructional capacity was assumed to be poor (EDC, 2004). As a result of the project's mandate and the political environment, the *English is Fun* IRI series had a single, primary goal: to expand access to a full course of instruction in English language to students in the primary grades. The classroom teachers – assumed to have poor pedagogical and content knowledge in the teaching of English – were included in delivering this primary goal as a member of the 'teaching team' (EDC, 2006; Friend, 1985). In other words, the classroom teacher had a role in delivering English instruction to students but only in a way that did not necessitate the teacher to have rich pedagogical and content knowledge in English language instruction.

In direct contrast to the primary goal of the project, a secondary goal of the *English is Fun* IRI series was grounded in the IRI design itself – to address the poor pedagogical and content knowledge of classroom teachers. As a secondary goal, the *English is Fun* design adopted a dual-audience approach, in which the students were the primary audience and the classroom teacher was the secondary audience. Although teachers were not explicitly encouraged to engage in any instructional activities beyond setting up and managing the radio lessons, the design assumed that teachers would mimic the pedagogical practices embedded in the IRI lessons, which would lead to a more active role in instruction (Royer, 2006a).

Towards these goals, teachers were provided with five days of face-to-face training focused on the primary expectations (i.e., setting up the classroom, following instructions from the radio teacher); however, no additional face-to-face trainings aimed at improving

their pedagogical and content knowledge in English were provided. Furthermore, teachers were not made aware of any expectations beyond those articulated in the training; although teachers most likely engaged in conversations with classroom observers on the types of behaviors that were being observed and the types of behaviors thought most beneficial for student learning.

Throughout the IRI series, the explicit expectations were that teachers would facilitate the implementation of the IRI lesson (i.e., making sure students participated, setting up the IRI classroom, and following the radio teachers directions) while the implicit expectations of the dual-audience design were that at least some teachers were increasingly engaging in classroom instruction, although the program stated that the burden of instruction fell primarily on the radio teacher. The implicit, or secondary expectations, were grounded in the dual-audience approach of the IRI design and is supported by literature on the use of ICTs in classrooms. The ICT literature extensively documents the critical role of the classroom teacher, particularly in the effective use of the ICT with students, though this role has necessarily been minimal with IRI in developing countries (Judson, 2010; Wenglinsky, 2006; Wheeler, 2001; Wainer, 2008; Chung, 2002; Trotter, 1997; Warschauer & Matuchniak, 2010; Buendia, 2002; Chao-Hsiu, 2008). Furthermore, a review of literature regarding the role of the teacher in two types of ICTs in education – dissemination technologies and instructional technologies – suggest that the need for one-to-one guidance and communication is an essential component in an ICT classroom, although this interaction manifests itself differently with different technologies and learning conditions. With IRI and the one-way nature of the radio programs, this guidance and communication role must necessarily then be filled by the classroom teacher, despite the intentional goal of the IRI programs to unburden the teacher of this task.

The purpose of this study was to examine to what extent the IRI methodology, and particularly, the *English is Fun* IRI series in Delhi and Rajasthan, should isolate the instructional task to the radio teacher. In other words, did the implicit design of the IRI programs better prepare classroom teachers to provide the guidance and communication that students needed, and which could not be embedded in the radio program itself? The focus of my study was to examine to what extent the classroom teacher's practice in the primary goal – i.e., primary expectations – influenced students' English proficiency and the extent to which teachers' practice in the secondary goal – i.e., secondary expectations – influenced students' English proficiency. Was the instructional task appropriately isolated to the radio teacher, or were teacher practices in the secondary expectations, in fact, a necessary element for improving student outcomes?

Review of the Analytical Approach

This quantitative study utilized data from a program evaluation of the Interactive Radio Instruction program implemented in Delhi and Rajasthan under the USAID-funded *Technology Tools for Teaching and Training (T4)* project. In this study I used both descriptive analyses and Hierarchical Multivariate Linear Modeling (HMLM) to examine the extent to which teacher practice in the primary and secondary expectations influenced student outcomes in English proficiency. Teacher practice was examined with data collected using the Classroom Observation Tool; this tool captured the frequency that teachers demonstrated each desired behavior during the IRI lesson. Students' English proficiency was examined using tests administered to students in a face-to-face, one-on-one format between a trained examiner and the student. In both states, the testing instruments included questions designed to assess students English listening skills, vocabulary acquisition, and sentence usage.

I used student assessment data for 682 students in Delhi and Rajasthan who participated in the IRI intervention in 2009-2010 as well as classroom observation data for their teachers (32 in total). Students' English language proficiency was measured using gain scores in listening, vocabulary, and sentence use from baseline to endline. I estimated teachers' observation scores using Bayesian-weighted scores from a series of multilevel regressions on the available observation for each teacher (teachers received between one and six observations). Using these weighted observation scores, I then generated mean scores for each teacher on each of two expectations based on project staff grouping of items; these mean scores were subsequently standardized to facilitate interpretation.

The multivariate multilevel model used in this study accounted for the nested nature of the data, namely assessment scores nested within children nested within classrooms/teachers. Multilevel modeling in this study allowed me to empirically determine the influence of the classroom teacher's practice in the primary and secondary expectations on students' English language proficiency, and more importantly, to answer the question "which types of practices mattered most?"

Findings and Interpretation

The study addressed two main research questions. I discuss the findings and my interpretations of the findings for each research question next.

Research Question 1

The first research question asked "how do student English proficiency gains in English listening, vocabulary acquisition, and sentence use vary significantly between classrooms/teachers who participated in the intervention?" The answer to this first research question provided a context for interpreting results from the second research

question: namely, "how do teacher practices associated with each of the expectation scales influence students gains in English listening, vocabulary acquisition, and sentence use?" The answer to the first research question involved preliminary analyses of relevant data and the estimation of a Level 1 model.

The final project report for the English is Fun IRI series cited that the average student test scores in English speaking and comprehension in Delhi and Rajasthan varied by teacher (EDC, 2012). Similarly, I expected that, even when I re-examined the proficiency scores using the WIDA framework, students' English language proficiency for each of the three scales would vary between classrooms/teachers. While I expected differences in student performance for the comprehension test based on the literature of both IRI research and ICT research (EDC, 2012; Toyama, 2015; Hoffer, 2008), I ran the analyses for the speaking test by separately examining students' scores on vocabulary acquisition and sentence use based on the WIDA framework.

Based on the literature and prior research (EDC, 2012; WIDA, 2012) I expected differences in student English proficiency such that students would have the highest gains in listening, followed by vocabulary acquisition and sentence use. This hypothesis was based on the relative difficulty of developing speaking skills for students learning English as a second language and as suggested by this framework. Specifically, when it comes to speaking skills for students learning English as a second language, vocabulary acquisition is a relatively easier skill to build than sentence speaking skills; and listening skills is a relatively easier skill to build than vocabulary knowledge (WIDA, 2012).

Summary of Findings

The Intraclass Correlation Coefficient (ICCs) from the fully unconditional models for listening, vocabulary, and sentence use indicated that the variance in students' English

proficiency was attributed to factors beyond the student level (Level 1 of the model). The ICCs for listening, vocabulary, and sentence use indicated that approximately one third of the variance in student gain scores was attributable to teacher-level variables. This finding provided initial support that teacher practices in the primary and secondary expectations may explain a portion of children's gain scores in English listening, vocabulary acquisition, and sentence use.

At level 1, I also examined average gain scores in each skill area to determine the magnitude of the gains in English listening, vocabulary acquisition, and sentence use. The magnitude of the change in students test scores in sentence use (8.8 percentage points) was smaller than the magnitude of change in students test scores in both other skills (15.7 percentage points for listening and 17.3 percentage points for vocabulary). Furthermore, there were noticeable differences in gain scores in sentence use between Delhi and Rajasthan – namely, that students in Delhi made larger gains in sentence use (11.4 percentage points) than did students in Rajasthan (6.8 percentage points). Gains in listening and vocabulary acquisition were higher than sentence use in both states, although the highest gain scores were observed in the acquisition of vocabulary (14.5 percentage points in Delhi, 19.4 percentage points in Rajasthan), contrary to what I anticipated.

Alignment with Hypothesis

These findings largely are aligned with the study's hypothesis and demonstrate that a) students English language acquisition varied among teachers and b) speaking sentences is a more difficult linguistic task than either listening or the acquisition of vocabulary for students learning English in IRI classrooms in Delhi and Rajasthan, though I anticipated that vocabulary acquisition would be more difficult than listening gains. The relatively smaller gains in sentence use compared to gains in listening and vocabulary – in both

states – aligned with one component of the hypothesis. However, the study's findings also suggest that students made the largest gains in vocabulary use – even larger than in listening skills. While vocabulary use is a relatively more difficult linguistic task than is demonstrating listening skills in English, the study's findings did not support the hypothesis that student's would demonstrate the highest gains in listening.

Research Question 2

The second research question asked "how is student's proficiency in English influenced by the extent to which teachers satisfy the primary and secondary expectations in an IRI classroom?" This research question builds upon the findings in the first research question, and was the focus of my study. In the second research question, I sought to measure whether there is a relationship between teacher practice (i.e., the extent to which teachers are observed to be satisfying the primary and secondary expectations during the IRI lesson) and student performance (i.e., the gains in their English listening skills, vocabulary and sentence usage). Furthermore, I sought to identify which teacher practice mattered most – is it the extent to which teachers satisfied the primary or the secondary expectations, or both? The answer to this question involved analyses of relevant data and the estimation of a Level-2 model.

For this analysis, I first computed teacher practice scores for each of the expectation scales guided by the design of the IRI teacher training (for the primary expectations) and the dual-audience approach of the IRI methodology (for the secondary expectations). The measures used to estimate teacher practice in this study were aggregated from the relevant items on the Classroom Observation Tool, which was based on prior research (Royer, 2006a). The measures represent average teacher practice on each expectation scale during the second half of the IRI series.

Based on the literature, I was expecting that teachers who were observed performing the behaviors in the secondary expectations more often were likely doing so as a result of mimicking the pedagogical concepts and techniques demonstrated during the IRI program (Ho & Thukral, 2009; Royer, 2006a), although neither of the studies cited included controls for exposure to pedagogical concepts and techniques outside the IRI programs. Second, the T4 project's final report (EDC, 2012) cited that teachers who were observed performing five specific desirable behaviors during the *English is Fun* IRI lessons were associated with higher average gains in student performance.[28] Third, research literature on ICTs used for dissemination and as instructional tools in the classroom suggest that teacher guidance – however that is manifested in the ICT approach – is still critical to the learning process. In the case of IRI, the behaviors in the secondary expectations capture, to a limited extent, a teacher's attempts to guide students through the content presented by the radio characters. In line with these studies, I anticipated that, even though my study used measures of teacher practice at the factor or composite level (rather than individual item level), the relationship between teacher practices and student performance would also be positive and confirm the influence of teacher practices on student gains in English language proficiency in an IRI classroom.

[28] To recap: the data from Rajasthan shows that the teacher's role in conducting the activities in each lesson and doing so in ways that are responsive to student learning needs *with confidence* has an impact on students speaking and comprehension test scores. Teacher observation data from Rajasthan also show that students whose teachers were *always* demonstrating the desired behavior significantly outscored students whose teachers were observed to demonstrate the desired behavior *sometimes* or *never*. Observation data on teacher behavior from Delhi show that the teacher's ability to effectively manage the classroom (i.e. follow instructions given by the radio characters), use pauses to ask questions aimed at facilitating students understanding, facilitating IRI activities in ways that are responsive to students learning needs, and facilitating a positive environment – all while doing so with confidence – had a bearing on student test scores in speaking (EDC, 2010).

Summary of Findings

After controlling for differences within classrooms in children's demographics such as age, gender, student caste and father's highest level of education, and differences between teachers who had more or fewer observations or more or fewer students, the study's findings demonstrate that the average listening gain was 12.5 percentage points with no significant difference between students in Delhi or Rajasthan; the average vocabulary gain was comparable to the listening gain (although for every additional observation visit, students made 1.3 percentage points greater gains in vocabulary than in listening and with every additional student in the classroom, the average vocabulary gain score increased by 0.4 percentage points). The average sentence gain was 7.1 percentage points *lower* than the average gain in listening and vocabulary.

When examining the influence of teacher practices, the findings show differences in gain scores by state and by the extent to which teachers satisfied the primary and secondary expectations. Students in Rajasthan gained 12.5 percentage points in listening, regardless of their teacher's observed practices; for students in Delhi, however, teacher practice mattered. A student in Delhi whose teacher scored higher on the primary expectations than other teachers had practically no listening gains whereas a student in Delhi whose teacher scored higher on the secondary expectations gained on average 33.8 percentage points. With vocabulary acquisition, a student in Rajasthan or Delhi whose teacher scored higher on the primary expectations than other teachers gained an average 3.2 percentage points whereas a student in Rajasthan or Delhi whose teacher scored higher on the secondary expectations gained an average 19.2 percentage points in vocabulary. With sentence use, a student in Rajasthan or Delhi whose teacher scored higher on the primary expectations than other teachers actually had an average *negative* gain of 5.5

percentage points whereas a student in Rajasthan or Delhi whose teacher scored higher on the secondary expectations than other teachers had a positive gain of 11.7 percentage points.

Overall, the extent to which teachers in both states satisfied the primary and secondary expectations of the IRI program was associated with gains in listening and vocabulary; although for listening gains, teacher practice only mattered for students in Delhi. Students in classrooms where teachers were observed to have the highest levels of compliance with the primary expectations (e.g., setting up the classroom, turning on the radio, following the radio instructor's directions) had the lowest gains in listening, vocabulary, and sentence use; students in classrooms where teachers were observed to have greater levels of activity associated with the secondary expectations (e.g., interacting with students with confidence, adding to the IRI content, facilitating activities) had the highest gains in listening, vocabulary, and sentence use. With sentence use there was actually a negative gain associated with teacher practices in the primary expectations (at one standard deviation above the mean).

Alignment with Hypothesis

The study's findings with regards to the second research question confirm my hypothesis that there is a relationship between students' English proficiency and the level of teacher practice in an IRI classroom, but I did not anticipate that there would be a negative association with the primary expectations.

Congruent with the findings of the *T4 Report Final Project Report* (EDC, 2012), I too expected that students' English proficiency is related to teachers' practice. Two major limitations of that report (EDC, 2012), however, were that the relationships were examined at the item level and the analysis did not account for the nested nature of the

data. When the average frequency across observations of teacher practice for each individual item was correlated with student gain scores in comprehension and speaking, only one item was found to have a significant correlation with student gain scores in Rajasthan. In my study, that item is classified as a secondary expectation (the item reads: "teacher facilitates IRI activities in a way that is responsive to student learning needs"). In Delhi, of the four observation items that were reported to have a significant correlation with student gain scores in comprehension and speaking, two were classified as secondary expectations in my study (those items read: "asking questions to facilitate students understanding" and "facilitating IRI activities in a way that is responsive to student needs").

While this study generally corroborates the earlier findings, it also broadens the scope and examines the relationship between teacher practices and student outcomes in three skill areas and most importantly, examines the relative influence of these teacher practices on student gains. In contrast to earlier findings, I did not expect that there would in fact be a negative effect on student's sentence use when teachers in Delhi or Rajasthan had higher than average scores on the primary expectations scale.

This suggests that there may be a threshold (or optimal) level of function on the primary expectations scale, beyond which there is in fact a *negative* effect on student gain scores. One possible explanation for this finding may be that teachers observed with higher level of function on the primary expectations scale were doing so at the cost of the secondary expectations. In other words, teachers whose focus was greater on the primary expectations that were explicitly conveyed to them – either intentionally or as a result of poor pedagogical and content knowledge – were unable to maintain momentum with the in-service modeling across the 120-lesson series and had the lowest levels of activity when

it came to mimicking the modeling around sentence use. Since the data analyzed in this study represents the latter half of the series, the scripts for this portion of the series over-emphasized the types of supports necessary for students to make gains in the most complex linguistic task addressed in the IRI programs – sentence use. If teacher were in fact performing primary expectation tasks at the cost of secondary expectations, then this cost may have been greater when it came to the latter portion of the IRI series.

Alternatively, the negative influence of the primary expectations on sentence use may also suggest that there may be an optimal level of teachers' content knowledge in English. The data used in this study did not include any measures of the teacher's own command of the English language. With a greater level of reinforcement for listening activities and vocabulary activities by the radio characters, the lower level of the classroom teacher's performance in the secondary expectations may not have had as significant an impact as on sentence usage, where the level of teacher-led activities and need for reinforcement was greater by design (Friend, 1985). In order to fully explore these alternative explanations, to determine whether thresholds for the primary expectations scale or teachers' content knowledge existed, and if they existed, what those thresholds were, requires additional data on the proportion of time spent by teachers on the primary and secondary expectations and assessments of teachers' English knowledge across the entire IRI series. These studies are suggested for future research.

Discussion

Although I anticipated that both the primary and secondary expectations for the IRI program would have a positive relationship with English proficiency gains, this was not the case. Primary expectations were associated with lower gain scores while secondary expectations were associated with higher gain scores. In the case of gains in sentence use

– the most difficult linguistic task assessed of IRI students in Delhi and Rajasthan – the relationship with primary expectations actually resulted in negative gains. Teacher practice clearly mattered but not in the same way, or for all three skill areas.

In reviewing the results from this study, I identify important general interpretations of the results and three specific – and related – interpretations. Generally, these findings have important implications for the way the classroom teacher is cast in both project contracts and in discussions with government officials where the mandates of the project are negotiated. Secondly, and more importantly, these findings have important implications for future designs of the IRI programs.

The important relationship between the two outcomes for the audiences of the IRI series is one that is not directly addressed in either the literature that documents the early IRI methodology (Friend, 1985; Leigh, 1985; Searle, et al., 1974; Searle, et al., 1978) or that documents the modern IRI designs (Bosch, 1997; Bosch, 2006; Hartenberger & Bosch, 1996; Potter & Naidoo, 2013). The lack of treatment of this relationship in the literature leaves the influence of outcomes for teachers on outcomes for students assumed rather than examined. As I hypothesized with my second research question, the two audiences may be served differently by the IRI program, but an important relationship exists between the outcomes for teachers (in terms of changes in their practice) and outcomes for students (in terms of the gains they make). This relationship is also necessary – as suggested by ICT research on dissemination and instructional technologies; the one-way nature of the radio cannot accommodate a teacher's guidance of the students' learning and this role must therefore be filled by the classroom teacher.

Based on the relationship between outcomes for teachers and outcomes for students, I identify three specific interpretations of the results of this study: a) that in the

latter half of the IRI series, there may be an optimal scenario for teacher practice on the primary and secondary expectations in an IRI classroom that leads to significant gains for students in all three skill areas; b) that the expectations placed on teachers may actually vary across the year such that, as the IRI series progresses, the primary expectations are de-emphasized and the secondary expectations are emphasized; and in support of this second interpretation, c) that continued, explicit face-to-face support during the course of the year may produce greater gains in student performance in the most complex linguistic tasks addressed by IRI programs. These interpretations provide a context for further consideration in the design and implementation of *English is Fun* IRI programs.

Optimal Teacher Practice to Maximize Student Gains

The magnitude of students' gain scores when teachers had higher levels of average practice varied significantly between states and role expectations. During the latter half of the IRI series (which the data used for this study draws from), the optimal scenario for maximizing student gains is one in which average teacher practice on the primary expectations is *below* average and on the secondary expectations *above* average. Table 5.1 summarizes the influence of teacher practice on student English proficiency when teachers had above average scores on each expectation scale; the table also highlights the optimal scenario in which a teacher has *below* average scores on the primary expectations and *above* average scores on the secondary expectations.

In this scenario, the greatest gain in Delhi student's scores was observed in listening when a teachers practice is one standard unit *below* other teachers in the primary expectations and one standard unit *above* other teachers in the secondary expectations – the average listening gain score in this scenario was 50.1 percentage points. Students also had the greatest gains in vocabulary and sentence use under the same scenario, 28.6 and

22. 6 percentage points, respectively. In Rajasthan, the greatest gains in student's scores was observed in vocabulary when a teachers practice is one standard unit *below* other teachers in the primary expectations and one standard unit *above* other teachers in the secondary expectations – the average vocabulary gain score in this scenario was 28.6 percentage points. Students also had the greatest gains scores in sentence use under the same scenario, 22.6 percentage points.

Table 5.1 Optimal Scenario of Teacher Practice to Maximize Student Gain Scores

Outcome	**Average Practice both Expectations**	**Above Average Practice - Primary Expectations**	**Above Average Practice - Secondary Expectations**	***Below* Average Practice - Primary Expectations and *Above* Average Practice - Secondary Expectations**
	Intercept	1 SD *above* mean	1 SD *above* mean	**Primary**: 1 SD *below* mean and **Secondary**: 1 SD *above* mean
DELHI				
Listening Gains	16.38	0.08	33.78	50.18
Vocabulary Gains	12.52	3.24	19.30	28.58
Sentence Gains	5.38	-5.52	11.65	22.55
RAJASTHAN				
Listening Gains	12.52	12.52	12.52	12.52
Vocabulary Gains	12.52	3.24	19.30	28.58
Sentence Gains	5.38	-5.52	11.65	22.55

In interpreting the results more broadly, this scenario demonstrates that the relationship between outcomes for teachers and outcomes for students deserves attention, particularly by designers of the IRI program. Not only are outcomes for teachers and outcomes for students related, there is a real potential to maximize student learning in the second half of the IRI series. Put differently, the average student in Delhi made gains as

high as 50 percentage points and students in Rajasthan made gains as high as 29 percentage points *when* their teacher satisfied the secondary expectations more frequently than the average teacher *and* satisfied the primary expectations less frequently than the average teacher. [29,30] Drawing from the ICT literature, the classroom teacher with higher levels of practice in the secondary expectations is filling a gap in the learning process left by the radio – by providing one-to-one guidance and communication to students that the radio programs cannot. This limitation, and the need to incorporate the teacher, was also recognized in early iterations of the IRI design, where teachers were incorporated to provide reinforcement of student responses. The results of this study, however, take this even further – that the classroom teacher is necessary to fulfill an even larger instructional role than the IRI design seems to have intended.

This optimal scenario also reflects the increasing importance of the secondary expectations *by design* in the IRI lessons and as suggested by the ICT literature. Since these data reflect teacher practice during the latter half of the IRI series, the sequencing of content across IRI lessons meant that during this portion of the IRI series, students were learning more complex linguistic tasks, including vocabulary acquisition and sentence use. By nature of the IRI design, the role of the teacher was necessarily more important, since the longer activities could benefit from greater involvement from the teachers. When students practiced speaking, teachers could provide additional and possibly necessary

[29] To reiterate, the secondary expectations included the following items from the Classroom Observation Tool: facilitating the IRI lesson with confidence, appearing comfortable managing students, facilitating the activities in a way that is responsive to student learning needs, engaging all students equally in IRI activities, providing additional guidance to help students better understand content, adding his/her own 'flavor' to the IRI activities to enhance student learning and enjoyment, and asking questions in various ways to facilitate students understanding.

[30] Primary expectations included the following items from the Classroom Observation Tool: student seating arrangement is adequate, teacher distributes questions to all students, teacher is adequately able to follow instructions given by the radio characters, teacher facilitates a positive environment in the classroom, teacher encourages students to respond to questions posed by IRI characters, teacher tries to keep all students engaged in IRI activities, and teacher spends more time on instructional tasks than on administrative tasks.

reinforcement that the radio teacher could not be able to provide (Friend, 1985). Although the data show that, even under this optimal scenario, learning gains for students were lowest in sentence use (compared to gains in listening and gains in vocabulary acquisition), that the gains were positive and larger in magnitude than under other scenarios supports the need to deliberately account for – and design for – the conditions in this optimal scenario in future IRI programs.

This first interpretation of the results leads to the second interpretation – that if there is an optimal balance of teachers' practice with regards to the primary and secondary expectations in the second half of the series, then the assumption that the classroom teachers' role remains constant throughout the IRI series may warrant re-examination.

Primary Expectations May be Time-Bound

For the first half of the series, the primary expectations may in fact be most important (although the current study did not examine this); however, the importance of these primary practices may be time-bound. During the second half of the IRI series, on which the current study focuses, the implied or secondary expectations of the teacher to provide pedagogical and content support may be more important than those practices in the primary expectations. The greater gains observed for students when the primary expectations are de-emphasized and the secondary are emphasized during the second part of the series may suggest that the importance of the primary expectations may in fact have ceased over time. Put differently, the relationship between the primary and secondary expectations, and their relative influence on student learning in the three skill areas, may actually vary across the course of the academic year.

In the first half of the IRI series, it seems reasonable that a teacher's ability to set up the IRI classroom, ensure that seating is adequate, follow instructions given by the

radio characters, and encourage students to respond to questions and keep all students engaged – would all be important in ensuring that, at the very least, the IRI lesson took place. The project staff's concern with ensuring that IRI lessons took place was real – and undergirded the use of classroom observers to provide help to teachers who were struggling with getting the IRI lesson started and students participating. Once these 'start up' challenges were addressed in the first half of the year, the observers served solely in the capacity of an observer.[31]

Although the teacher's abilities to set up and persist in an IRI lesson may have been addressed with the help of the observers, the extent to which teachers actually *met* the primary expectations during the first half of the IRI series, remains unknown. Despite this lack of data, I expect that a classroom in which an observer intervened to help the teacher address 'start up' challenges would also have been one in which, if observation data were to be recorded, the teacher would have gotten low scores on the primary expectations and low, if not negligible, scores on the secondary expectations. The implications for this are as follows: that the primary expectations may not only be time-bound but that there may be an optimal level necessary before teacher practice in the secondary expectations is detectable. Beyond this optimal level of teacher practice in the primary expectations, the benefits to students diminish – as is evidenced in the data analyzed for this study. In other words, the primary expectations' importance may not only decrease over time, but may only be important *until the point a teacher has reached an optimal value*, after which their practice in the secondary expectations becomes most important. This interpretation and inference of the data also points towards possible areas of future research, particularly in examining the relationship between the two expectations

[31] Note: I discuss the potential for these observers to continue providing support, particularly in the Secondary Expectations, in the next section.

across the entire IRI series, and in examining their relative influence on student outcomes at multiple time points during the IRI program.

Explicit Support to Teachers in Pedagogical and Content Knowledge is Important

The previous two interpretations of the results are important considerations for re-examining the conceptualization of the classroom teacher's role in an IRI lesson – both from the perspective of an IRI designer but also from the perspective of funders and government officials who prescribe the parameters within which the IRI project is implemented (and in turn, the level of face-to-face support allowed). The third interpretation of the study's findings addresses the level of support provided to teachers particularly in realizing their full potential in the secondary expectations – as undergirded by literature on the role of the teacher in an ICT classroom. First I discuss the potential role of classroom observers and second the need for face-to-face teacher trainings during the course of the academic year.

The T4 project staff utilized the classroom observation visits in the early part of the IRI series to provide support to teachers who were struggling with basic implementation of the IRI program. The relative importance of the secondary expectations over the primary expectations, at least as judged by observations during the latter half of the series, suggests that continued support for teachers across the IRI lifecycle may be essential to maximize the observed outcomes for teachers and students. Such continued and explicit support, over and above the in-service modeling via the IRI lessons, may in fact produce learning gains greater than those seen in this study – given that the gain scores observed in this study were when teacher supports were only provided implicitly.

Through this explicit support, teachers may in fact be more receptive to the in-class modeling, particularly if they have a forum in which they are introduced to the techniques before they are modeled in the IRI lessons and if they have an opportunity to ask questions and better understand the strategies that the IRI programs advocate. For example, when a teacher is asked by the radio characters to continue an activity with the students, any issues or concerns the teacher faced in doing so (both in that particular IRI program and in subsequent ones) go unresolved. As such, there may be a higher likelihood that teachers, despite their willingness or efforts to mimic these strategies and behaviors, would be unable to conduct an activity every time the teacher is asked to use a technique that she already finds challenging. Face-to-face trainings can be used to introduce, practice, and problem-solve the various strategies and behaviors embedded in the IRI lessons so that the likelihood of low observation scores in the secondary expectations – due to misunderstanding or lack of clarity – are minimized.

In summary, the findings from this study suggest three important interpretations that can be instructive to the IRI methodology itself and to program implementation and training. First, that teacher and student outcomes from participating in the IRI lessons may each be unique but are critically related – so much so that student outcomes are maximized under a specific scenario of teacher outcomes. Second, that the importance of the primary expectations may be time-bound beyond which the influence on student outcomes not only diminishes but is detrimental to student learning. Third, that the influence on student outcomes may in fact be understated in this study if instead teachers received explicit, face-to-face support in the secondary expectations during the second half of the IRI series. The findings from this multivariate multilevel study go above and beyond what was previously known based on the relationship between individual

classroom observation items and student outcomes (as reported in the 2012 evaluation results for the T4 project).

Limitations

In identifying potential implications of this study on the design and implementation of IRI programs in the future, it is warranted to identify the limitations of the study. As with any research study, several limitations exist. In addition to methodological limitations, such as the number of assumptions and correct model specifications, I identify four areas of concern that may impact the conclusions that can be drawn from this study. These include a) that the data used for the analyses were drawn from only two of eight states in which the T4 project was actively implementing the *English is Fun* IRI series, the inadequacy of controls for location given the differences between states and that the data only includes classroom observations from the second half of the program; b) control variables to account for the level of exposure to English outside of the IRI programs were not included in the study; c) the English proficiency levels and pedagogical practices of teachers were assumed to be poor from audience research but were not directly measured and there was a lack of control variables to account for teacher practice outside of the IRI lesson; and d) the multiple iterations and changes to the IRI methodology between the late 1990's and the T4 project's development of the *English is Fun* IRI series in 2002 may not be fully described in design documents available in print from EDC or in peer-reviewed research journals; for the design of the *English is Fun* series, too, I relied solely on project documentation.

First, the limitations of the dataset itself were such that it only included IRI results from two of the nine states in which the T4 project was being implemented, of which eight states were implementing similar versions of *English is Fun.* Using results from Delhi and

Rajasthan to generalize to all states participating in the *English is Fun* IRI series may be limited because the classroom observation data used for this analysis covered half of the year and may provide an incomplete overall picture of the relationship between teacher practice in the primary and secondary expectations, and because the relative influence of each expectation may differ for each state. However, given the similarities in the IRI, teacher training, and tools used to assess students and observe teachers, some of the interpretations may be valid for all states participating in IRI programming (particularly the importance of recognizing and addressing the relationship between student and teacher outcomes, and its changing nature across the IRI series). With results for listening, the absence of an effect for teacher practice measures in listening in Rajasthan may have been the result of differences in the assessment. Additional states' data were not used in this analysis because teacher and student data were not available for the same classrooms.

Second, the study did not include controls for the extent of students' exposure to English outside of the IRI classroom. The dataset consisted of student and teacher data from two geographically and politically distinct states in India. Although geographically close, Delhi and Rajasthan differ not only in education policies for government-supported schools, but also in the English levels of its residents. Specifically, residents in Delhi generally have higher proficiency in English as a result of Delhi's urban status and as the country's capital with one of the highest concentration of expatriate (non-Indian) residents. The interaction terms that I included in the model attempted to estimate the differences between states in the influence of the teacher practices variables, but they may not have done so effectively.

Third, teachers' poor skills in pedagogy and English content knowledge were assumed in this study based on focus groups conducted by the project as part of the

audience research. While the focus group data may have been sufficient to determine the general programmatic approach, the absence of direct measures of teachers' English content knowledge and pedagogical skills meant that teachers' prior English knowledge could not be controlled for in the study. As such, the study's results include not only the practices and behaviors that teachers mimicked from the radio characters, but also their prior English content knowledge and pedagogical skills. Furthermore, the dataset did not include measures of teacher practice outside of the IRI lesson, and therefore could not be included as controls in the study.

Fourth, evaluations of the impact of IRI on student outcomes were conducted by consultants and research institutions in the early 1980's and 1990's and since then, evaluations have primarily been conducted by the implementing partner, EDC. Documentation on the IRI methodology has also been maintained primarily by EDC since the 1990's, with little to no research on the methodology itself in peer-reviewed research journals.[32] This lack of documentation left a gap between the prior studies in which the early conceptions of the role of the classroom teacher were first articulated in the Nicaragua and Kenya IRI series; but any advances in these conceptualizations through various IRI projects in multiple countries have not been synthesized and documented.

To characterize the role of the classroom teacher in the *English is Fun* series, I relied primarily on project documentation – including the project's contract and the embedded scope of work, the training manual used for the five-day teacher training prior to the start of the IRI series, the Teacher's Guide, and the training for classroom observers

[32] Multiple searches were conducted on EbscoHost using the search terms "Interactive Radio Instruction" and "IRI", as well as on Google scholar using the same search terms. Searches were conducted throughout the course of the writing of this dissertation, between 2012 and 2015. Google scholar results did yield some journals that were moderated and maintained by universities in South Africa and open-access journals, some of which have been cited in Chapter 2.

and the Classroom Observation Tool. I used these project resources and the earlier research on the IRI methodology to infer the underlying conceptualization of the classroom teacher's role in the *English is Fun* IRI programs in Delhi and Rajasthan. Although this approach was insightful, discrepancies between the true conceptualization of the classroom teacher's role and my rendering of that role may exist.

Future Research

Although this study contributes importantly to the literature on the IRI methodology and provides important considerations for implementation of IRI programs in developing contexts such as India (particularly when IRI is implemented as a means to increase access to quality instruction when teachers have poor skills in both pedagogy and content), the study has its own limitations and makes way for further research. One such study, suggested in a previous section, involves an examination of the relative importance of the two expectations across the *entire* IRI series of lessons as well as examining the relative influence of teacher practice in each of the expectations on student learning outcomes at multiple time points during the IRI program. These studies can further our understanding of the relationship between teacher practices and student outcomes and how these may change over the course of the IRI program.

A second potential study that emerges out of my study involves an examination of the optimal levels, or thresholds, for teacher practice in the primary and secondary expectations. This study would examine changes in teacher practice over time as well as identify whether threshold levels of teacher practice on each of the two sets of expectation exist. As discussed earlier, there may in fact be an optimal level of teacher practice when it comes to the primary expectations, beyond which point the benefits to student learning diminish and are actually detrimental to student's acquisition of more complex language

skills, such as sentence usage. The same may be true for the secondary expectations – particularly if teachers' prior pedagogical skills and content knowledge are controlled for. For this study, assessment data on teachers' English content and pedagogical skills would be necessary, along with classroom observations across a full IRI series.

Conclusions

Despite the limitations, these results suggest that not only does teacher practice influence student outcomes in an IRI classroom, but that the extent to which classroom teachers satisfied secondary expectations has a greater, positive influence on student outcomes than the extent to which they satisfied primary expectations, at least during later lessons. By examining the influence of teachers' practice on students' English proficiency, the study provides a starting point to reconsider the way in which the role of the classroom teacher is conceived in the IRI methodology (again, to the extent that it has not been synthesized and documented since the late 1990's) and to advocate for implementation of teacher support mechanisms throughout the life of the IRI project. The importance of the classroom teacher's role – even when the primary goal of the project is to improve student's learning outcomes – was established through this study. Despite the stated goals of increasing access to instruction for students and minimizing the classroom teacher's role, the implicit approach of expanding the classroom teacher's role in the IRI series produced notable gains for students.

The results offer support for the IRI methodology's dual-audience approach, specifically that the IRI programs' equal prioritization of both audiences – students and teachers – as recipients of the IRI program – remains important. However, the results further the dual-audience concept in that the relationship between the outcomes for the two audiences are necessarily related and raise important considerations for maximizing

student learning. To maximize gains, further research is necessary to inform IRI design as is the explicit treatment of the secondary expectations in the implementation of future IRI programs.

Appendix 1. Delhi Student Assessment Tool: English is Fun

Instructions: The facilitator identifies ten children from class I and class 2 each as per the sampling procedure given in the IRI Test administrator's guideline. For each question, be sure to remind students that they are to answer in English, and in complete sentences whenever possible.

Question	Question / instructions	Coding
Colours		
Group (practice session) – tippy tap	***Practice and warm-up:*** The facilitator gathers 10 children and makes them sit around him/ her. Instructions are given in English then in Hindi. Facilitator tells them that the game requires them to touch the cloth colour called out. 2 pieces of clothes (white, orange) are placed in the middle of the circle so that all students can reach each cloth easily. The game is called Tippy-tippy-tap. Facilitator begins the game by demonstrating. "Tippy tap. "Point to the colour ….white". Facilitator points to the white cloth. Continue practicing with white, orange. Note: do not practice with test colours listed below. Facilitator tells students that now each of them will answer individually. All the children are asked to sit in the corner of the class room or in another room and each child will be called one by one. The facilitator removes the orange and white clothes and it is replaced with five other coloured clothes (blue, red, green, yellow and black). Place the cloths near the student being tested, and away from the other students.	No coding/ marks for practice session
Question 1 Individual assessment – Tippy tap	Identifying colours Call 1 student and ask them to sit in front of the cloths. Ask the child to say : Tippy-tippy-tap Child says: Tippy-tippy-tap Facilitator responds "I want _____(colour)" (say the following colours one by one, giving enough time in between for student to answer. • Blue • Red • Green • Yellow	If the child touches the correct colour asked for give**"1",** If the child touches wrong colour or no response, give **"0"**

	• Black The child responds by touching the colour asked for. The facilitator notes down the student's responses. This is repeated with all the 10 children, individually.	
Question 2 Leading the game – tippy tippy tap	Leading the game Call back all the 10 children and make them sit together. Ask the children who wants to be the leader (volunteers) and continue the game of tippy-tippy-tap. Children take turns to be the leader (not all children in the group might volunteer to do so). They can be encouraged to take the initiative. The same procedure is followed. The child who has become the leader has to play the role of a facilitator. The group will say: Tippy-tippy-tap The child Facilitator is then given time to ask " I want _____ (and name any of the colours shown around the class). Allow enough time for the child to ask the question, without assisting him/her. • Blue • Red • Green • Yellow • Black Then the group will move and touch that particular colour. There is no score for the responses given by the students. Marks are given only to the child who has volunteered to be the leader	Leader score: For any student who comes forward to be a leader, score will be "1" If the student doesn't come forward to be the leader, score will be "0". Response score: If the child facilitator asks the question **"I want …….. colour" in full sentence in English**, score will be **"3";** If the child facilitator asks "…….. (just colour)" in English, then score will be "2" If the child facilitator asks in Hindi, "……..." then the score will be "1" If the child does not ask at all, then score will be "0"
Vocabulary		
Question 3 Individual assessment – bag of objects	Bag of Objects All the ten children are asked to sit together. Facilitator stands in the middle of the group, and calls the first child up to the bag.	Record the name of the object shown by the student If the child responds in **full sentence in**

(group setting)	Facilitator shakes a bag that contains the following objects: • Plate (steel / plastic) • Glass (steel / plastic) • Bottle (a small plastic bottle) • Shoe (small, neat) • Pencil (unsharpened, for safety) • Pen (ballpoint, with cap) • Book (small) • Bell • Chalk • Comb The facilitator gives instructions **slowly** in English, then again in Hindi: This bag has many nice things. Let's see what is inside this bag. You will come up one at a time, touch one thing, feel it and guess what it is. Then you will show it to all of us. The facilitator might demonstrate how this is to be done. *Note: Instructions MUST be given in English first, and then in Hindi.* Note: The object used in demonstration is removed from the bag and kept out for the remainder of the activity. Facilitator calls each child up to the bag individually, tells them to put their hands in and hold ONE object. The facilitator asks "What is it?" Student then pulls out the object and shows it to the facilitator and gives the response in English. Object is placed aside and game continues with next student.	**English " This is a……..",** the score will be **"3"** If the child responds in a single word " pen" in English, the score will be "2" If the child responds in Hindi, "……..." the score will be "1". If the child does not respond or wrong response, the score will be "0"
Letters and Words		
Group (practice session) – Letters and words	Game: Matching letters and Objects With all students in a group, show students the "letter B" flashcard. Facilitator gives the following instructions first in English then in Hindi: We will now play a game of letters. I will show you a card with a letter, and you have to say the name of the letter. Then, I will ask you to point to the object that starts with that letter.	No coding/ marks for practice session

	practice with all students: (showing letter B flashcard). Facilitator asks: "What letter is this?" (Pointing to the letter). Allow students to answer and encourage others to participate. After students have correctly identified the letter, facilitator asks: "Now look at these three objects. (Showing objects on flashcard). Which one of these objects starts with the letter above?" (IN HINDI) Encourage students to think about the letter-object relationship.	
Question 4 Individual assessment – letters and words	Now facilitator calls each student individually, and shows them 1 flashcard at a time. Ensure that other students cannot see the flashcards or hear the student's answers. While showing the card to the student, facilitator will ask: Question 1: "What letter is this?" (Pointing to letter shown on card). Question 2: Which one of these objects starts with the letter? (IN HINDI) Flashcards will be shown to students as follows: • Letter D, with pictures of horse, dog, train • Letter A, with pictures of apple, shirt, and girl	Record the response: For Question 1: Letter correctly identified in English – "1" Incorrect answer or no answer, Hindi – "0" For question 2: Points to correct picture – "1" Points to wrong picture, no response – "0"
Vocabulary		
Question 5 Individual assessment – flashcards	Flashcards Ask students, one by one, to come to the facilitator and tell them to identify the pictures in the flashcards. Remember to have all other students sit so that they cannot see the flashcards. Flashcards will have pictures of the following: • Elephant • Banana • Cat • Orange • Dog • Mango • Cow	If the child responds in **full sentence in English " This is a ……"**, the score will be **"3"** If the child responds in **a single word " pen" in English,** the score will be **"2"** If the child responds **in Hindi, "……..."** the score will be **"1"** If the child does not respond or wrong response, the score will be "0"

	• Apple • Goat • Triangle The child should be asked **to respond in English and in complete sentence** such as "This is an/a…….". As each picture is shown to the child, the facilitator asks the question: What is this?	
Group (practice session) – pictures	Game: Pictures With all students sitting in a circle around the facilitator, the facilitator shows two Pictures one after another to the group. Allow the children to see both pictures, and think about what is shown. Then tell the students that they will be asked individually to name objects in the pictures. When they name objects they should do so in English, in a complete sentence, and they should try not to name objects previously mentioned by other students.	No coding/ marks for practice session
Question 6 Individual assessment (group setting)- pictures	Call 1 student forward and ask them to look at the first picture. Ensure that other students are not able to see what the student being tested points to. Showing picture 1 to the student, facilitator asks first in English then in Hindi: • Point to one object in this picture. • What is it? (ask in English) Then, showing picture 2, facilitator asks Showing picture 2 to the student, facilitator asks first in English then in Hindi: • Point to one object in this picture. • What is it? (ask in English only)	For both Pictures 1 &2, Record the name of the object shown by the student. If the child responds in **full sentence in English " This is a ……"**, the score will be **"3"** If the child responds in a single word " pen" in English, the score will be "2" If the child responds in **Hindi, "……..."** the score will be **"1"**If the child does not respond or wrong response, the score will be "0"
Group (practice	Game: Interview With all students sitting in a group, facilitator tells the students that he/she will now ask them	No coding/ marks for practice session

session) – interview	questions, and the students have to do their best to answer in complete sentences in English. Students are called up, one at a time. Practice questions for each student: "Good morning, how are you?" Or "What is your name?" During practice, facilitator should ensure that the student understands that they are to answer in English and in a complete sentence such as "Good Morning, I am fine"; 'My name is……."	
Question 7 Individual assessment - Interview	Then each child is called for testing individually and asked the following questions. Be sure other students cannot hear the question and answer given by the student being tested. Facilitator reminds students to answer in a complete sentence, and in English. 1. Good morning, how are you? 2. What is your name? 3. How old are you? 4. What is the name of your mother? 5. How many brothers do you have? 6. How many sisters do you have? 7. Which colour do you like? 8. Which fruit do you like?	If the child responds in **full sentence in English "My name is ……"**, the score will be **"3"** If the child responds in a **single word " ……." in English,** the score will be **"2"** If the child responds in **Hindi, "……..."** the score will be **"1"** If the child does not respond or wrong response, the score will be "0"
Actions and gestures		
Group (practice session) – actions	Game: Actions The facilitator gives the following instructions in English, then in Hindi, with demonstration: Let's play a game. I am the leader. Listen and then do what I ask you to do. Practice with all students: Clap your hands. (Facilitator does the action, and encourages students to follow).	No coding/ marks for practice session
Question 8 Individual assessment - actions	Facilitator tells students that now he/she is going to ask them to do different actions. Facilitator calls one student, and asks them to do what they ask: 1 Clap your hands. 2 Jump 3 Sit down / stand up 4 Touch your nose 5 Stamp your feet	Record the response: Correct action – **"1"** Incorrect action or no action – "0"
Body parts		
Question 9	Children are sitting in a group, but are seated in a way that does not allow them to see each other's	Record the response:

- Individual assessment – body parts	papers. each student is given a worksheet that has images of a 1. Pair of eyes 2. Nose 3. Teeth At the bottom of the page these words are written in English. Children are told to match the pictures with the words given and then write the correct word against each picture. This will bring in vocabulary in a different context and the combined skills of reading and writing Marks will not be deducted for incorrect spellings, even though children were only required to copy	If they do **only matching** or **only writing**, the score will be "1" If they **do not do anything**, the score will be "0"

Appendix 2. Rajasthan – Student Assessment Comprehension Test

Sample Items

Page No. & Item No.	Question	Picture 1	Picture 2	Picture 3	Marking Scheme
Sample Pg 1 Item No 1	*इन चित्रों में अपनी उंगली **BUS** पर रखें।*	*There will be only one picture BUS*			*No marks*
Sample Pg 1 Item No 2	*इन चित्रों में अपनी उंगली **HOUSE** पर रखें।*	*Glass*	*Dog*	*House*	*No marks*
Sample Pg 1 Item No 3	*इन चित्रों में अपनी उंगली **PENCIL** पर रखें।*	*Pencil*	*Bag*	*Car*	*No marks*

Items

Page No. & Item No.	Question	Picture 1	Picture 2	Picture 3	Marking Scheme
Page 2, Item No 1	इन चित्रों में अपनी उंगली **ELEPHANT** पर रखें।	Lion	Elephant	Monkey	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response
Page 2, Item No 2	इन चित्रों में अपनी उंगली **CAT** पर रखें।	Cow	Cat	Dog	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response
Page 2, Item No 3	इन चित्रों में अपनी उंगली **GOAT** पर रखें	Goat	Cock	Tiger	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response

Items

Page No. & Item No.	Question	Picture 1	Picture 2	Picture 3	Marking Scheme
Page 3 Item No 4	इन चित्रों में अपनी उंगली **NUMBER 5** पर रखें	3	5	2	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response
Page 3 Item No 5	इन चित्रों में अपनी उंगली **NUMBER 9** पर रखें	9	7	6	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response

Items

Page No. & Item No.	Question	Picture 1	Picture 2	Picture 3	Marking Scheme
Page 4, Item No 6	इन चित्रों में अपनी उंगली **GIRL IS STANDING** पर रखें	Boy is Sleeping	Girl is Sitting	Girl is Standing	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response
Page 4, Item No 7	इन चित्रों में अपनी उंगली **GIRL IS EATING** पर रखें	Girl is running	Girl is Eating	Girl is jumping	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response
Page 4, Item No 8	इन चित्रों में अपनी उंगली **FIVE FLOWERS** पर रखें	Three flowers	Five flowers	Two flowers	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response

Items

Page No. & Item No.	Question	Picture 1	Picture 2	Picture 3	Marking Scheme
Page 5, Item No 9	इन चित्रों में अपनी उंगली **BOOK UNDER THE TABLE** पर रखें ।	Book on the table	Book under the table	Book near the table	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response
Page 5, Item No 10	इन चित्रों में अपनी उंगली **PENCIL ON THE BOOK** पर रखें।	Pencil in the glass	Pencil on the book	Pencil under the chair	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response

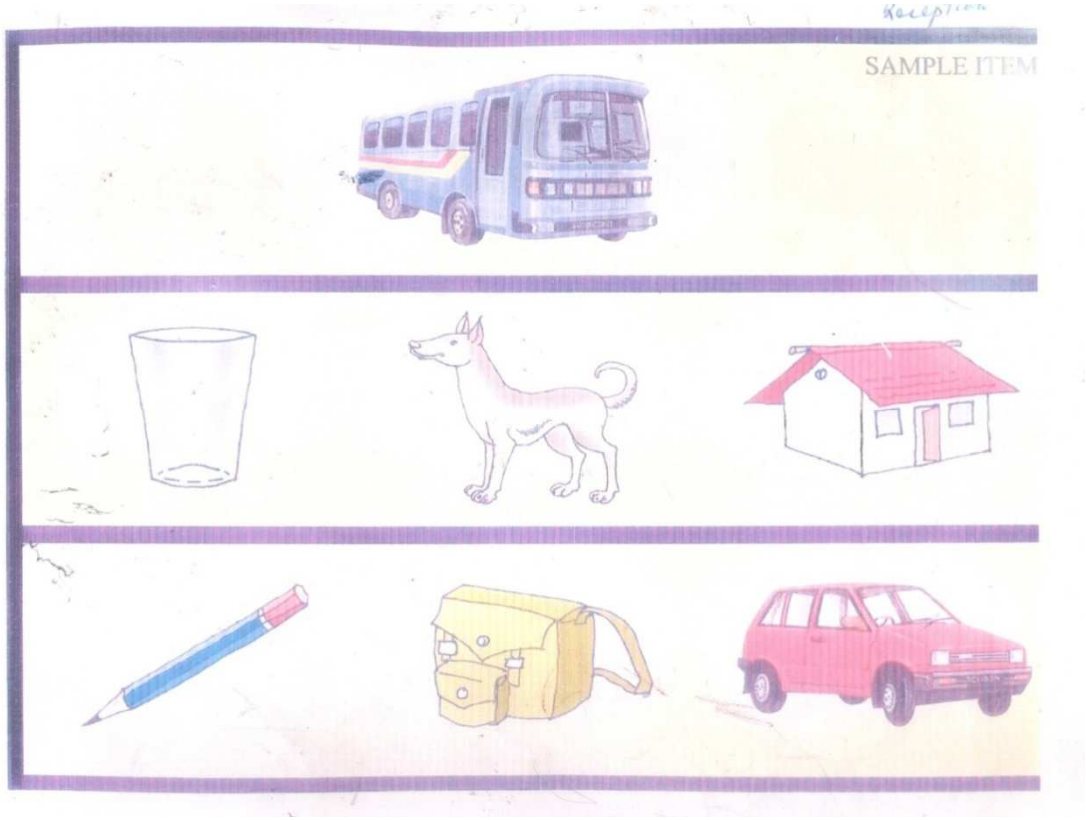
Items

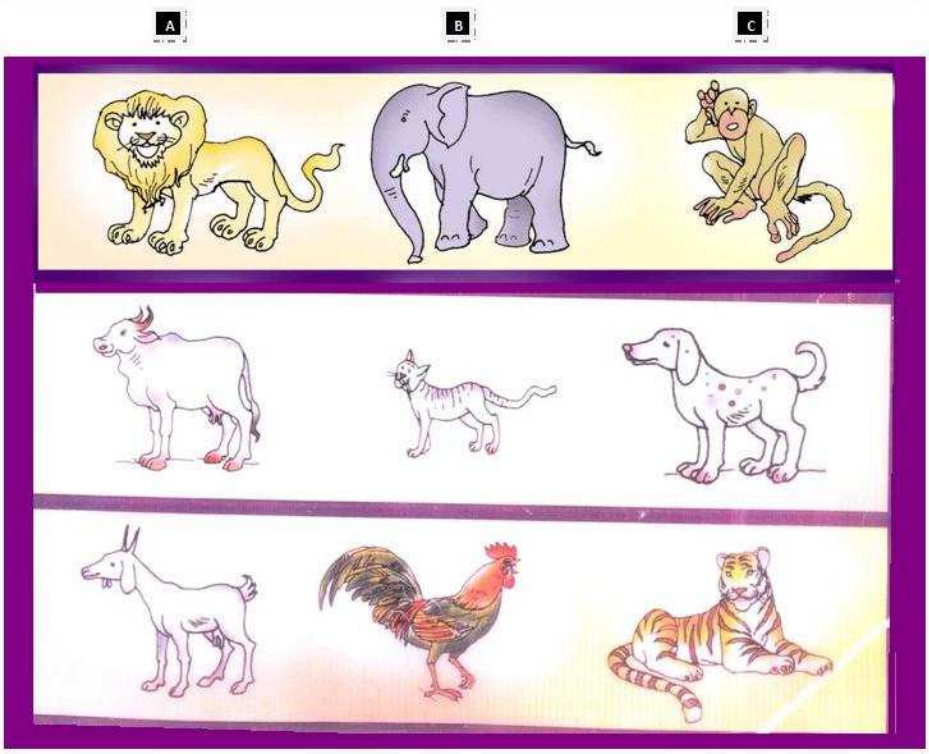
Page No. & Item No.	Question	Picture 1	Picture 2	Picture 3	Marking Scheme
Page 6, Item No 11	अपनी उंगली **Tree** पर रखें।	Tree	Table	Bench	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response
Page 6, Item No 12	अपनी उंगली **Letter C** पर रखें।	C	S	T	If a student points to the give **1 mark**. Otherwise, write the **code** of the pictures, write '0' in case of non-response

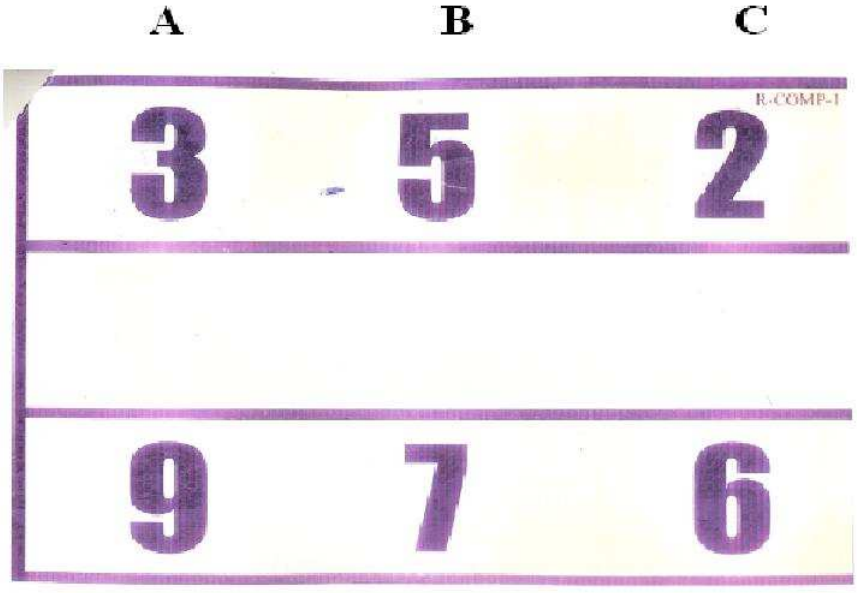
Appendix 3. Rajasthan – Student Assessment Speaking Test

Item 1	What is your name?	**3 marks** for "My name is ……..." **2 mark** for only giving the name. 1 mark for responding correctly but in hindi 0 marks for incorrect responses
Item 2	Are you a Boy/Girl? (Depending on whether the student is Boy or Girl)	3 marks for "Yes I am boy /girl"", 2 mark for "boy/girl." 1 mark for responding correctly but in hindi 0 marks for incorrect responses
Item 3	(pointing to **One eye)** What is this?	3 Marks for " This is an eye", 2 mark for "eye". 1 mark for responding correctly but in hindi 0 marks for incorrect responses
Item 4	(pointing to a Chair) What is this?	3 Mark for"This is a chair. 2 Mark for "chair" 1 mark for responding correctly but in hindi 0 marks for incorrect responses
Item 5	(pointing to picture of Boy is sleeping) What is he doing?	3 mark for "The Boy is sleeping/ He is sleeping", 2 mark for "Sleeping" 1 mark for responding correctly but in hindi 0 marks for incorrect responses
Item 6	Do you have three noses?	3 mark for "No, I do not have three noses", 2 mark for "No". 1 mark for responding correctly but in hindi 0 marks for incorrect responses
Item 7	(pointing to picture of Green Flower) What colour is this?	3 marks for "This is a green flower". 2 mark for " green " 1 mark for responding correctly but in hindi 0 marks for incorrect responses
Item 8	What day is today?	3 mark for "Today is ……", 2 mark for "Only for Day" 1 mark for responding correctly but in hindi 0 marks for incorrect responses

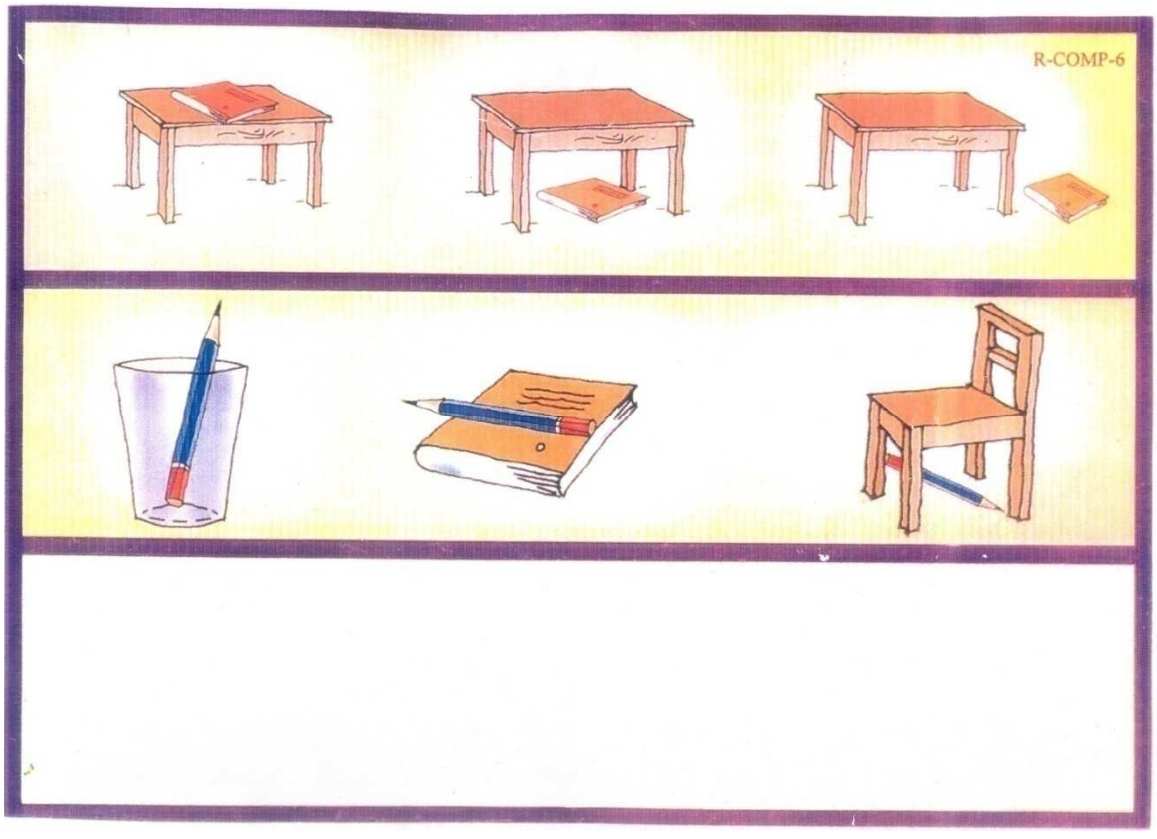
Appendix 4. Rajasthan - Picture Cards for Speaking and Comprehension Test

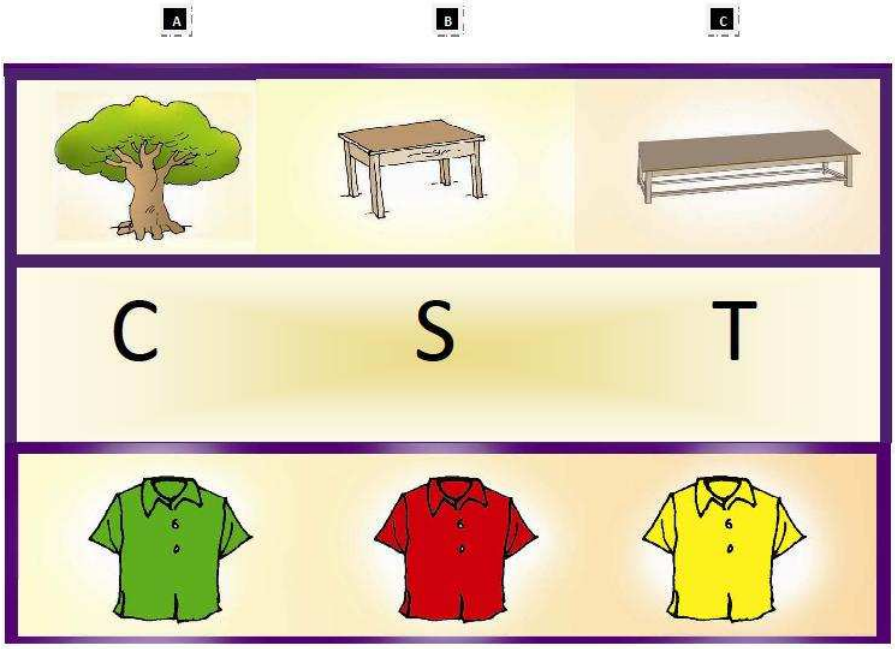


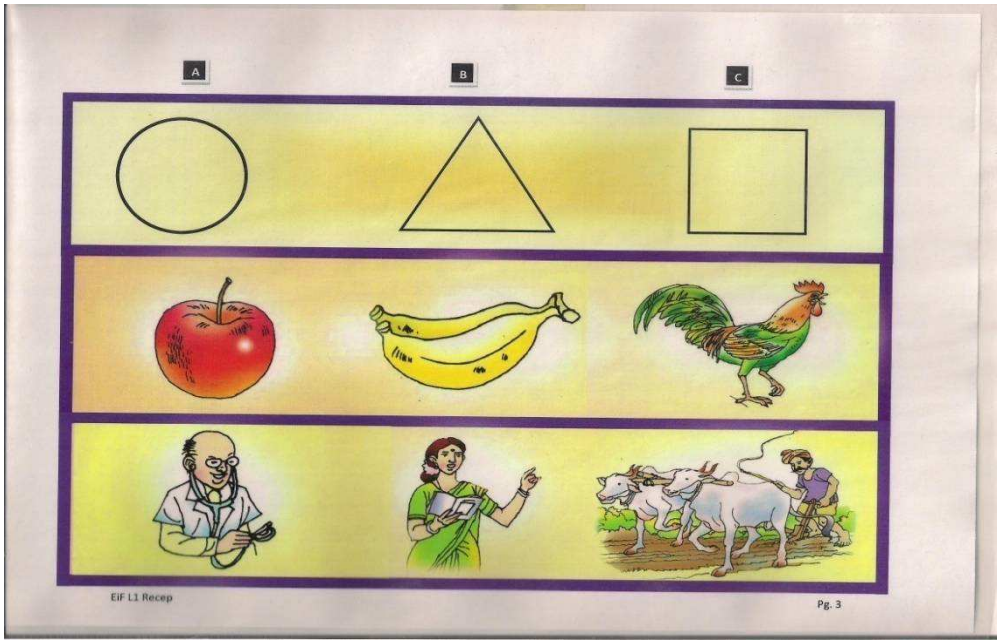

A
B
C


A
B
C
R-COMP-1
3 5 2
9 7 6


R-COMP-3


R-COMP-6


A
B
C
C S T


A
B
C
EiF L1 Recep
Pg. 3

Appendix 5. Teacher Observation Tool for IRI

Instructions for Observers:

You will be conducting classroom observations to document the role of the teacher in an Interactive Radio Instruction (IRI) classroom, and to record the impact of IRI on the teacher. Since the quality of your visit and the observations you record on this format depend entirely on how honest and comfortable the teacher feels, you should first ensure that the teacher is well aware of why you are conducting the observation, what you are recording, and what you will use the information for. Be sure to let them know that you will not share the data you collect with their superiors; the data will be summarized across several teachers and several observations and only this summary will be shared with others.

The purpose of your visit and this observation tool are as follows:

1. To observe and record how the teacher implements the IRI program in his/her classroom
2. To observe and record the impact of the IRI program on teacher behavior, learning, and practice
3. To understand the challenges faced by the teacher in facilitating the IRI program
4. To provide handholding support to the teacher for improving the IRI experience in his/her classroom

Once you have oriented the teacher adequately to the purpose of your visit, prepare yourself for the observation session. First, select an appropriate place to sit which is not in direct view of the students or the teacher – you may want to sit in the back and to the side so your presence is not a disturbance during the IRI classroom. Remember, you should not participate in the IRI lesson unless the teacher requests your assistance, or if he/she is having great difficulty facilitating the lesson (in which case you may want to provide some guidance, and follow up with them after the program as well).

Second, work your way through this tool. The tool has six sections. You will complete the first section prior to the start of the IRI broadcast. During broadcast, you will take detailed notes of what you are observing in the classroom in the second section. Based on the detailed notes in section 2, you will reflect on your observations and respond to specific items in the same section. In section 3, you are asked to reflect on your previous observation in relation to the current one, and make notes of the nature and types of changes you have observed in the teacher's practice, behavior and learning. Next, you will sit

with the teacher and engage in a discussion with them. Based on your discussion, you will respond to items listed in section 4. In section 5, you are asked to provide your general observations, and in section 6, any recommended actions that can help the teacher improve the IRI experience in his/her classroom. Remember, the ultimate objective of this task is to build the capacity of the teacher to handle the IRI program as per its basic philosophy and core principles.

Prior to arriving at the school, be sure to have oriented yourself to the content of today's lesson (review Teacher's Guide).

Name of the School: _____ School Code: _____ Date of visit: _____ Visit Number: _____

Name of Zone/ Block:_____ **Name of Cluster**:_____ **Name of observer:** _____

Name of the Teacher being observed: _____ **Class observed**: _____ Lesson No. _____

No.	Item	Response score	Describe what you saw in the classroom to support your Score	Response codes
SECTION 1. Classroom Observation – Before Broadcast Be sure to arrive in the classroom at least 15 minutes before the beginning of broadcast so you may make adequate observations to respond to the following items. Then, based on your observations during this period, provide the response score that is most appropriate for each item.				
1.1	Did the teacher conduct any pre- broadcast activities with students? **Indicators**: Teacher conducts an exercise or activity as suggested in the Handbook; teacher reviews material from previous lesson(s); teacher engages students in other activities to prepare for the broadcast			1 – Yes 2 – No
1.2	In preparation for today's lesson, did the teacher reference the correct page from the Guidebook?			1 – Yes 2 – No

No.	Item	Response score	Describe what you saw in the classroom to support your Score	Response codes
1.3	In preparation for today's lesson, has the teacher prepared the required TLMs?			1 – Yes 2 – No 3 – TLMs were not required in today's lesson as per the Handbook
1.4	In preparation for today's lesson, has the teacher arranged students appropriately in the classroom? **Indicators**: note the activities for the day and the arrangements suggested in the Guidebook. Has the teacher seated students or grouped students as required/ as given in the guidebook?			1 – Yes 2 – No
1.5	Overall, has the teacher made adequate preparations for today's lesson?			1 – Yes 2 – No 3 – no preparations were required

SECTION 2. Classroom Observation – During Broadcast Once the broadcast begins, take detailed notes on what you observe in the classroom in the following section. Note the teacher's actions, the interactions with students, how the teacher facilitates the IRI program, type of TLMs used, how the teacher tries to improve his/her own English speaking and comprehension skills, how the teacher does/doesn't facilitate student engagement with the program, and in what ways the teacher enhances the content of the program. Take specific notes that will help you reflect on the items in the next section.

SECTION 2A: Reflection on Observations Based on your observations recorded above, reflect on the IRI lesson, overall. As you reflect on what you saw today respond to each of the items in the following section.				
Sl. No	Items	Response score	Describe what you saw in the classroom to support your Score	Response codes
2.1	Student's seating arrangement **Indicators:** Were the students seated in such a way that all were able to participate? Did the students have sufficient space to participate in the activities? Could the teacher have arranged students in an alternative way that would better facilitate their participation? Students were seated in such a manner that all were able to listen to the IRI program?			1 – Adequate 2 – Somewhat adequate 3 - Inadequate
2.2	Teacher facilitates IRI activities in a way that is responsive to students learning needs **Indicators:** Did the teacher adapt activities/content appropriate for students learning level? Did teacher make additional efforts with specific students who may have had difficulty with an activity/concept/content? Has he/she made use of common examples for explaining to the children?			1- No 2 – To some extent 3 – Most of the time
2.3	Teacher tries to keep all students engaged in the IRI activities **Indicators:** Teacher moves around the classroom to keep all students' attention on the IRI program, teacher encourages students who aren't participating			1- No 2 – To some extent 3 – Most of the time

2.4	Teacher spends more time on instructional tasks than on administrative tasks during IRI pauses **Indicators:** Teacher spends more time on explaining content or facilitating an activity than on maintaining order in the classroom (keeping students quiet, managing student behavior, finding TLMs, taking attendance or any other Non- IRI activities)			1- No 2 – To some extent 3 – Most of the time
2.5	Teacher tries to engage all students equally in each IRI activity **Indicators:** teacher facilitates all IRI activities with comparable effort and interest (games, songs, activities, review, etc.); teacher does not consistently ignore a particular type of activity			1- No 2 – Engages in some activities only 3 – Engages in all activities equally
2.6	Teacher is adequately able to follow instructions given by the radio characters **Indicators:** Teacher knows when to pay attention to the broadcast for instructions; teacher can immediately do what is asked, teacher doesn't get nervous or feel anxious when asked to do something by the radio characters			1- Unable 2 –Able, but to some extent 3 – Fully Able

2.7	During pauses, teacher asks students questions in various ways to facilitate their understanding **Indicators:** Teacher asks a mix of simple/moderate/difficult questions as appropriate for student understanding; teacher frames questions in different ways to facilitate student engagement			1- No 2 – To some extent 3 – Significant variety
2.8	Teacher distributes questions to all students **Indicators:** Teacher asks questions to a variety of students instead of concentrating questions to a select group of students			1- No 2 –Most questions posed to some students 3 – Questions posed to most of the students
2.9	Teacher reviews select topics immediately following the broadcast **Indicators:** Teacher reviews concepts immediately following the broadcast that may have been difficult for students during the IRI lesson; teacher extends activities started during the IRI lesson to encourage greater participation among students; teacher facilitates additional activities to further student understanding of a concept introduced during broadcast			1- No 2- Limited review occurs after broadcast 3 – Sufficient time is given to review after broadcast
2.10	Teacher facilitates the IRI lesson with confidence			1- Teacher lacks confidence throughout lesson 2 –Teacher is somewhat confident 3- Teacher is confident throughout lesson

2.11	Teacher appears comfortable managing students during group activities **Indicators:** Teacher is comfortable with the level of noise and interaction during group activities; teacher encourages students to interact with each other during group activities; teacher does not feel the need to centrally control student activity			1- Never 2 – Sometimes 3 – Always
2.12	Teacher adds his/her own "flavor" or touch to an IRI activity to enhance student learning and enjoyment			1- Never 2 – Sometimes 3 – Always
2.13	Teacher encourages students to respond to questions posed by IRI characters			1- Never 2 – Sometimes 3 – Always
2.14	Teacher provides additional guidance to students to help them better understand the content presented by IRI characters **Indicators:** Teacher provides additional information from Guidebook to explain a concept; teacher references a familiar story or idea to students to help better explain a concept; teacher references materials in the classroom environment to provide another way of looking at the same content			1- Never 2 – Sometimes 3 – Always

2.15	Teacher facilitates a positive environment in the classroom **Indicators:** Teacher promotes student participation; teacher makes efforts to participate with the students in the interactions with radio characters; teacher allows each student time/space to participate in the program; teacher is not concerned only with eliciting the correct response; teacher makes efforts to engage students interest			1- Never 2 – Sometimes 3 – Always
2.16	Teacher utilizes TLMs that are appropriate for today's lesson			1- Not appropriate 2 – Somewhat appropriate 3 – Very appropriate
2.17	Teacher allows students to use TLMs			1- TLMs used only by teacher 2 – TLMs used by both teacher and students 3 – TLMs not required in today's lesson
2.18	Teacher is confident in using TLMs			1 – Not at all confident 2 – Confident to some extent 3 – very confident

2.19	Teacher appears to make efforts to improve his/her own English speaking skills **Indicators:** Teacher tries to learn English alongside students; teacher does not feel embarrassed about improving his/her own English; teacher tries to correct mispronunciation by trying to repeat English words and/or referring to Guidebook			1 – Not at all 2 – Makes some effort 3 – Makes significant efforts
2.20	Teacher appears to make efforts to improve his/her own English comprehension skills **Indicators:** Teacher tries to learn English alongside students; teacher does not feel embarrassed about improving his/her own understanding of vocabulary presented; English; teacher tries to correct his/her own misunderstanding by referring to Guidebook			1 – Not at all 2 – Makes some effort 3 – Makes significant efforts
SECTION 3. Comparison to Previous Observations Based on your observations today, reflect on the teacher's performance in comparison to your previous observations of the same teacher.				
3.1	In what aspects has the teacher's teaching style changed, in comparison to your last observation?			

3.2	In what aspects has the teacher's facilitation skills changed, in comparison to your last observation? Consider how comfortable the teacher is with conducting IRI activities, how he/she anticipates and augments IRI activities, and the role he/she plays in bringing the IRI program "alive" for the students			
3.3	In what ways has the teacher's own English skills changed? Consider their speaking and comprehension skills. In what ways does he/she appear to be taking advantage, personally, of the IRI program to improve his/her own command of English?			
SECTION 4. Discussion with Teacher The following questions should be asked to the teacher during a face-to-face discussion. Be sure to engage in a discussion rather than asking these questions directly. To help you, question prompts are provided for you to engage in a discussion. Then, based on the overall discussion with the teacher, provide the response score that is most appropriate for each item.				
Sl. No	Items	Response score	Describe what you saw in the classroom to support your Score	Response codes
4.1	Has the teacher participated in IRI training? **Prompts**: When did you attend training? How did you like the IRI training? Where was the training held? Also include the informal orientations provided to the teachers if they have not attended the formal trainings			1 – Yes 2 – No
4.2	If yes, how many times has teacher attended an IRI training?			1 – Once 2 – Twice 3 – More than twice

4.3	How useful did the teacher find the IRI training, now that they have been conducting IRI in the classroom? **Prompts**: Now that you've been practicing IRI in the classroom, what do you wish the training had included/addressed? What aspect of the training did you find most useful to you when you returned to your classroom? What aspects were not useful to you at all?			1 – None of the training was useful 2 – Useful to some extent 3 – Most topics covered were useful, additional topics necessary 4 – All topics covered were useful; no additional topics needed
4.4	What is the frequency (regularity) with which the teacher conducts the IRI program in their classroom? **Prompts:** What did you think of yesterday's (or name another day) lesson? What activities did you/students enjoy the most? How was the broadcast quality on [day]?			1 – Regular 2 – Misses some programs 3 – Irregular 4 – Never conducts the program
4.5	Usefulness of the Handbook for conducting the IRI programme **Prompts:** What aspects of the handbook did you find most useful in conducting today's lesson? What did you feel was missing in the handbook, that would have been helpful to you today?			1 – Handbook was not useful at all 2 – Useful to some extent 3 – Extremely useful

4.6	In what ways does the teacher see his/her students benefitting most from the IRI programs	Write, in detail, the teacher's response here.
4.7	In what ways does the teacher wish the IRI program would have benefitted his/her students, but currently does not appear to be doing so?	Write, in detail, the teacher's response here.
5	General observations	
6	Recommended Actions	

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