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Preeti Kumar
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TEACHERS MATTER:

TRADITIONAL AND NON-TRADITIONAL MEASURES OF TEACHER QUALITY IN INDIA

by

Preeti Kumar

Presented to the Graduate and Research Committee

of Lehigh University

in Candidacy for the Degree of

Doctor of Philosophy

in

Comparative and International Education

Lehigh University

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Preeti Kumar

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Approval

Approved and recommended for acceptance as a dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Date

_____
Dissertation Director

_____
Accepted Date

Committee Members:

_____
Dr. Alexander W. Wiseman
Comparative and International Education
Program Director
Professor

_____
Dr. Peggy Kong
Comparative and International Education
Assistant Professor

_____
Dr. Qiong Fu
Counseling Psychology
Professor of Practice

_____
Dr. Lisa Damaschke-Deitrick
Comparative and International Education
Professor of Practice

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Abstract

In this age of educational globalization, much focus is on teacher quality as a factor to improve education quality worldwide. In India, teacher quality is blamed for the poor performance on the Programme for International Student Assessment (PISA) 2009. Policymakers are, therefore, looking at teacher quality as a measure to improve student performance. Through content analysis, this study investigates teacher quality in India using evidence from the National Curriculum Framework (NCF 2005), National Curriculum for Teacher Education (NCFTE 2009), and the National Policy on Education (NPE 2016). Furthermore, this study uses data collected from PISA 2009 testing to analyze teacher quality variables with student mathematics scores for India. The purpose of this mixed methods analysis is to identify and analyze both traditional and non-traditional measures of teacher quality and how teacher quality explains the variance in student performance in mathematics in India. The study provides a systematic framework for policymakers for further improving teacher quality in India. Also, the study indicates paths for further research in order to augment educational practices in India in order to secure better student achievement and improve the country's global standing.

Chapter One: Introduction

Teachers matter. There is a global consensus that quality teachers are pivotal to quality education (Azam & Kingdon, 2014; Darling-Hammond, 2000; Hanushek & Rivkin, 2003). Researchers have found that teacher quality impacts student performance (Abe, 2014; Fong-Yee & Normore, 2006; Goldhaber & Anthony, 2003; UNESCO, 2006). Drawing from the Coleman Report released in 1966, Goldhaber (2016) stated that teachers are the single most important school-related factor in student achievement and, thus, the idea that teachers impact children's learning moved to the forefront, where it remains today. In the literature, one may clearly see how intensely this focus has been placed upon teachers, to the relative exclusion of other factors influencing the quality of education.

Commenting on teachers occupying a central role in schools and the education policy of a country, Hanushek and Rivkin (2006) state "there is a prima facie case for the concentration on teachers, because they are the largest single budgetary element in schools" (p. 1053). In addition, the Organization for Economic Co-operation and Development (OECD) sets forth the frequent assertion that among the school variables that are "open to policy influence, teacher quality is the single most influential factor in determining student achievement" (2005, p. 2). Therefore, it is apparent that the role of teachers in student learning is given dominant status, which, as a result, places much pressure upon teachers who seek to serve their students' learning needs as best they can.

Given the global consensus on importance of teacher quality in influencing quality of education that students attain, it is surprising that there is no "standard" definition or measurement of teacher quality. Ways to measure and estimate teacher quality are questions not specifically answered. Thus, Goe and Stickler (2008) comment:

> While many studies attest that some teachers contribute more to their students' academic growth than other teachers, research has not been very successful at identifying the specific teacher qualifications, characteristics, and practices that are more likely to improve student learning. Unfortunately, this is just the information that education policymakers need the most. (p. 1)

Countries across the world conceptualize and measure teacher quality in various ways. In many countries, teacher certification and professional development are used as a component to define teacher quality. Wiseman and Al-bakr (2013) present teacher licensing, or certification, as a "ubiquitous component of national education systems and pre-service teacher education around the world" (p. 289). In the United States, teacher qualifications are used to measure teacher quality (Azam & Kingdon, 2014). Therefore, the importance of highly qualified teachers is reflected in the No Child Left Behind (NCLB) Act of 2001. And yet, another global understanding of what teacher quality entails is evident in China where it is expected that instructors be continuously engaged in professional development activities, leading them to become higher quality teachers who can better contribute to their students' achievement (Robinson, 2008).

A report by the OECD reveals that Brazil, a developing country like India, has taken many steps since the mid-1990s to improve teacher quality (2015). Specifically, the 1996 Law on National Educational Guidelines and Framework mandated that all teachers attain a university qualification with in-service training and an increased number of practice teaching days (OECD, 2015).

Wiseman and Al-bakr (2013) cite the ubiquity of quickly developing education systems in nations around the world measuring teacher quality on the basis of standardized student

achievement test scores (pp. 289, 291). Similarly, in Russia, teacher quality is determined by scores students get after completion of the eleventh grade, the final year of high school. Every student in the country takes the common entrance exam, the Unified State Exam (USE), that functions as a college entrance examination. The exam is considered high-stakes because of the massive number of students in Russia who participate. Thus, teacher quality is determined by the scores students get on the exam (Zakharov, Carnoy, & Loyalka, 2015).

Another way to estimate teacher quality based on students' test scores is called the "value added measure" (VAM) approach. This outcome-based approach takes the perspective that a good quality teacher is one who raises her or his students' academic growth from one year to the next year and is now being widely used in the United States (Azam & Kingdon, 2014).

In India, the context of the study, much focus is on teacher quality as a measure to improve educational quality. Although there is research on assessing teacher quality in India (Azam & Kingdon, 2014; Muralidharan & Sundararaman, 2011; Nanda, 2017), there is limited study on the clarity of the definition of teacher quality in the policies in India. Unfortunately, there is no concept of a highly qualified teacher, though the current Minister of State for Human Resource Development is extending the duration for teacher education in a bid to improve teacher quality (Nanda, 2017). Conducting a study in private schools in the Indian state of Uttar Pradesh, Azam and Kingdon (2014) propose using the VAM approach to assess teacher quality in India, too.

The global overemphasis on certain variables of teacher qualification, teacher certification, and professional development deemed "traditional" measures of teacher quality (Goe & Stickler, 2008) fails to consider that there are other "non-traditional" teacher quality

variables impacting student outcomes. These traditional and non-traditional teacher quality variables are the key factors in this study.

Wiseman and Al-bakr (2013) offer their critique of this global model of defining and measuring teacher quality by stating, "… the fact is that some teachers facilitate student learning better than others regardless of their educational preparation and expertise in the subject matter, as measured by their certification" (p. 291). They acknowledge that measuring teacher quality is, indeed, "elusive" (Wiseman & Al-bakr, 2013, p. 289), and they affirm that there are other factors that are related to students' learning in the classroom.

Problem Statement

The problem statement of this study is that despite India's poor performance on the Programme for International Student Assessment (PISA) 2009 being blamed on poor teacher quality, to date, there has been limited study undertaken to analyze India's performance on PISA 2009 in mathematics on the basis of teacher quality variables. This study can be used as a base or initial work for those interested in studying teacher quality in the other states in India and quality of educational resources in India.

It has been stated that the country's economic strength and the social well-being of its people are closely linked to the education sector of the country. Since India's independence in 1947, education as an important factor for the nation's development has been a major concern of the Government, which is reflected in its curriculum frameworks and education policies.

In India, the importance of teachers is recognized as influencing student learning and is embedded in the national education policies. The National Council of Educational Research and Training (NCERT) in India made a decision in 2004 to revise the existing National Curriculum Framework (NCF) to improve teacher quality through revamping the existing teacher education

with a vision to prepare every child in the country to grow in India's fast-changing world and global economy (NCERT, 2005).

The National Curriculum Framework for Teacher Education (NCFTE) 2009's vision, drafted by the National Council For Teacher Education (NCTE), is to make the teacher educational institutions into centers of research and practical training to improve teacher education and quality in the country (NCTE, 2010). A recent addition to the education policies in India is the National Policy on Education 2016 by the Government of India, that seeks to "address the unfinished agenda relating to the goals and targets set in the previous national policies on education and the current and emerging national development and education sector-related challenges" (Government of India Ministry of Human Resource Development [MHRD], 2016a, p. 6).

Studies conducted, though limited, have established the relationship between teacher quality and student outcomes in India (Azam & Kingdon, 2014; Muralidharan & Sundararaman, 2011**;** Singh & Sarkar, 2012). Azam and Kingdon's study (2014) in India on teacher quality in private schools reveals that teacher quality matters a "great deal" (p. 4) in students' achievement, and within schools, teacher quality varies, impacting student scores. Muralidharan and Sundararaman (2011) show how teacher incentives like performance pay help increase student performance, while Singh and Sarkar (2012) show how teacher practices in the classroom affect student performance.

For the first time, two Indian states, Tamil Nadu and Himachal Pradesh, participated in the PISA in 2009. The "embarrassing" results (Chhapia, 2013, p. 1), where India ranked second to last amongst 73 countries, resulted in the country opting out of the 2012 and 2015 rounds of the assessment (OECD, 2010). The results revealed that not more than 15% of the children (15

years of age) who participated in the testing could perform basic mathematics skills, shedding light on the education quality in the country (OECD, 2010). Furthermore, publicizing the poor performance in PISA 2009, an article in a leading Indian newspaper, *The Times of India*, stated that an eighth-grade Indian student is at a similar level to a third-grade South Korean student in mathematics; an eighth-grade Indian student in reading also, on average, is at Shanghai's second-grade level. Questions arose related to teachers, and teachers were blamed for the poor performance of students (Rao, 2013).

Significance of the Study

The significance or the purpose of the study is to show through evidence that teacher quality cannot be only measured by traditional variables of teacher qualification, teacher certification, and teachers' professional development and that there are other non-traditional variables that enhance teacher quality to improve student performance that policymakers are overlooking. Despite India's poor performance on the international benchmark, there has been limited study to analyze India's performance on PISA. Rather, there have been criticisms of the poor quality of Indian teachers and low education quality in the country. Due to its poor performance in 2009, India has consciously opted out of the 2012 and the 2015 PISA testing (Venkatachalam, 2017). However, per a recent leading newspaper report, the country is set to participate in PISA 2021 (Venkatachalam, 2017).

Given the evidence through studies (Azam & Kingdon, 2014; Muralidharan & Sundararaman, 2011**;** Singh & Sarkar, 2012) that teachers play an important role in student outcomes in India, it is important to analyze the various teacher quality variables and their correlation to student outcomes within the framework of the PISA 2009 testing to improve teacher quality in the country. This study looks into the latest national policies for education in

India to see how the policymakers address the teacher variables. Then the study identifies or uncovers teacher quality variables that are highly correlated to student outcomes in mathematics in India. The information on the highly effective teacher characteristics is generated by comparing the traditional and non-traditional teacher quality variables.

Accepting the fact that every country participating in the PISA assessment varies from one another on social, cultural, and economic factors, the study analyzes the teacher quality measures or variables related to the Indian context only, rather than making cross-national comparisons between teacher quality measures in India and the high performing countries on the PISA assessment. Such an unrealistic comparison would not assist India in making policy changes to enhance its teacher quality. The research is limited to the PISA 2009 data as India has only participated in PISA 2009 so far.

To ensure that students in India get access to quality teachers, the study provides evidence to policymakers to enable them to judicially focus on those teacher variables that highly relate to student outcomes in mathematics. For the policymakers, the educational system has limited resources, which should be deployed to maximize student outcomes. Therefore, the educational leaders and policymakers at the national, local, and school levels can use the information gained from this study in allocating and spending resources to focus on specific characteristics in teacher quality to improve student performance in mathematics.

Research Questions

The national education policies, including the NCF 2005, the NCFTE 2009, and the NPE 2016, in India are an integral part of the Indian education system that focus on improving teacher quality in the country. To understand how the policies address both the traditional and non-traditional measures of teacher quality, the study analyzes the documents. The study provides

information to policymakers to focus their resources and time on those teacher measures that explain the variance in the student outcomes in mathematics to improve the teacher quality in the country.

Thus, the first research question may be stated as two complementary questions:

RQ1a: How do Indian national education policy documents (NCF 2005, NCFTE 2009, and NEP 2016) frame traditional and non-traditional teacher quality characteristics in reference to student achievement gains?

RQ1b: How did Indian national education policy shift from 2005 to 2016 in reference to traditional and non-traditional teacher quality characteristics and national competitiveness?

By analyzing the traditional and non-traditional measures of teacher quality that impact student outcomes in mathematics, the study identifies those teacher quality measures that are highly associated with student performance in mathematics on PISA 2009 in India based on the OECD average score in mathematics. Both the variables are laid out in the key factors section of this chapter.

Using quantitative data analysis on PISA 2009 data, the study compares traditional and selected non-traditional measures of teacher quality. Thus, the second research questions governing the study may also be stated as multiple complementary questions as follows:

RQ2a: Which traditional teacher quality variables are most strongly related to student mathematics performance in India?

RQ2b: Which non-traditional teacher quality variables are most strongly related to student mathematics performance in India?

RQ2c: How are traditional and non-traditional measures of teacher quality differently related to student mathematics performance in India?

The research questions, therefore, validate or invalidate several assumptions regarding the focus by policymakers on traditional and non-traditional teacher characteristics and student achievement through the data collected from PISA 2009. The validation is essential if one wants to take a stance in the debate occurring in India regarding the nature of reforms needed in preparing high quality teachers who can enhance student performance.

Comparative and International Education

The field of comparative and international education (CIE) has been a topic of discussion since its inception, and there is much debate on what constitutes the field. It is, therefore, important to place the research topic within CIE's broad horizon. Also, placing this research within CIE helps explain the importance of the research study in improving educational processes locally and globally.

According to Epstein (1992), the terms "comparative" and "international," though used synonymously, are distinct. The comparative component of the field is more academic and analytical, explaining why "educational systems and processes vary and how education relates to wider social factors and forces," while the international component is more descriptive, focusing on "descriptive information about nations and societies and their education systems and structures" (Epstein, 1992, p. 409). The research here to a large extent fulfills the criteria of CIE outlined in the definition. It is comparative as it compares India's educational performance in mathematics with that of other countries that participated in PISA 2009. It is international as the teacher quality variables in this research are teacher characteristics that are deemed global or universal by literature review.

Cook, Hite, and Epstein state that comparative education "is held together by a fundamental belief that education can be improved and can serve to bring about change for the better in all nations" (2004, p. 27). The research here is based on the belief that within India, focus on specific teacher quality variables will assist in improving the teacher quality in the country and impact the education quality.

Furthermore, authors state that for any study to fall under CIE, comparison is an important characteristic (Brickman, 1966; Epstein, 1992). The inception of this research stems from "comparison" between India and the participating countries on the PISA 2009 assessment, where India's performance ranked second to last amongst 74 participating countries and regions.

Epstein (1992) also defines comparative education as "a field of study that applies social scientific theories and methods to international issues of education" (p. 409). In this research, human capital theory and world culture theory provide a framework to explain why India is focusing on teacher quality to improve the educational quality in the country.

Emphasizing the benefits of the appropriate use of comparative and international education, Noah (1984) observes that comparative and international education can assist various actors like policymakers and administrators and form an integral part of teacher education. Connecting this definition to the research, the main purpose of the study is to provide information to the policymakers in India to focus on those teacher quality variables that are related to student mathematics performance.

Bray and Thomas (1995) argue that most research in the field of CIE "requires multilevel comparative analysis in order to achieve a full and balanced understanding" (p. 488). The research questions fulfill this requirement of CIE as it looks at the macro-level by analyzing national policies and also the micro-level practices by analyzing PISA data on teacher quality

variables and student performance in mathematics. The purpose in conducting cross-national studies is so that researchers can use the comparative data to provide policy recommendations to nation-states. Unfortunately, in India, the PISA 2009 comparative data is merely used to criticize the quality of education and to blame teachers for the poor performance of students (Chhapia, 2013; Venkatachalam, 2017). Acknowledging the unique global and local connection provided by the field of comparative and international education, the study, therefore, uses the global comparative data on teacher quality towards reforming education at the local level and improving the education system in India.

Key Factors

The key factors considered in the study are context, teacher quality measures, and student outcomes. As mentioned before, there has been limited study in India on teacher quality with reference to PISA scores. Therefore, the context in this study is India with specific reference to the two states of Tamil Nadu and Himachal Pradesh.

Detailed information on the Indian context with respect to its socio-cultural factors, history, current state of teacher education, and the Indian education policies is provided in the next chapter. The information is relevant to the study as it reinforces the role a teacher has historically played in Indian society through student achievement. Recognizing the qualities required by such a teacher for today's students is of great significance given India's poor performance in PISA 2009. Although the focus of the study is India, literature from other countries is also included and analyzed due to the limited study conducted in India. Literature that highlights the traditional and non-traditional teacher quality measures that are included in the PISA 2009 school survey is considered for the study.

The categories and sub-categories of teacher quality measures are presented in Table 1. Both the traditional and the non-traditional teacher quality measures and the bullet points are derived from the PISA 2009 school questionnaire created by the OECD main survey (Core B Consortium, 2008) and the literature review.

Table 1

Categories and Sub-categories for Teacher Quality Measures

Traditional Teacher Quality Measures[a]	Non-Traditional Teacher Quality Measures[b]
Teacher qualification ● Initial education and degree ISCED5A in India is a graduate with a (B.Ed.) degree[c]. Teacher certification ● Valid general teacher certification by appropriate authority Professional development and supervision ● Teacher in-service training and participation in different activities enhancing teacher knowledge and skills	Teacher salary/performance pay ● Monthly pay and increments ● Performance pay based on assessment data ● Any monetary incentives to teachers Teacher absenteeism ● Number of days a teacher is absent from her/his class Teacher qualified in the subject mathematics ● Importance of subject-matter knowledge Teacher attitude ● Teacher relationship with student ● Teacher disciplinary measures

Note. Both the traditional and the non-traditional teacher quality measures and the bullet points are derived from the PISA 2009 school questionnaire created by the OECD main survey (Core B Consortium, 2008) and the literature review.

[a] The variables of teacher qualification, teacher certification, and professional development are deemed "traditional" measures of teacher quality by Azam and Kingdon (2014) and Goe and Stickler (2008).

[b] These variables are thus deemed as "non-traditional" by the researcher for the study and derived from literature review.

[c] ISCED5A in India is equivalent to a graduate with a (B.Ed.) degree (OECD, 2010).

The above key independent variables depicted for the study are operationalized in Chapter Three on methodology.

Finally, although NCF 2005 and NCFTE 2009 are official curriculum frameworks and NEP 2016 is an education policy, these three documents were chosen for analysis as they are an integral part of the Indian education system and contain discourse that is relevant to the study. Therefore, a brief overview of the chosen policies is given in the literature review, though their in-depth content analysis is included in the fourth chapter of the study, which is data analysis.

Chapter Two: Literature Review

The Indian states of Tamil Nadu and Himachal Pradesh participated in PISA 2009 and ranked the lowest (second from the bottom) in mathematics. It created a "shock wave in the country, blaming the quality of teachers alongside other factors like the linguistic-cultural discrepancy and socio-cultural disconnect" (Mitra, 2015). On teacher quality in India, Venkatachalam (2017) states:

> Education in most schools is one dimensional, with an obsessive focus on marks. Added to this is the lack of availability of trained teachers at all levels. Quality teachers are the missing link in the Indian education system. Although pockets of excellence exist, the quality of teaching, especially in government schools, does not meet the standards. (p. 1)

Despite the ongoing global debate on the best measure of teacher quality, there exists no empirical evidence in the literature to show which teacher characteristics or variables most impact student outcomes. Studies show that much focus by policymakers internationally and within India is on traditional measures of teacher quality like teacher qualification, teacher certification, and professional development (Akiba, LeTendre, & Scribner, 2007; Desimone, Smith, Baker, & Ueno, 2005; Hill, Rowan, & Ball, 2005, Kingdon, 2006; Lamb & Fullarton**,** 2001). However, studies have also revealed that traditional teacher variables have not made any significant difference in student outcomes in mathematics, and there are non-traditional teacher variables that affect student performance (Akello, 2015; Kingdon, 2007; Muralidharan & Sundararaman, 2011; Singh & Sarkar, 2012). This dissertation thus adds to the literature by comparing both the traditional and non-traditional teacher variables to study which have the most influence on student performance in mathematics.

Organization of Literature Review

The literature review in this study reviews articles on the Indian education system, which focus on teacher quality to show its transformation from a traditional culture to a modern culture by competing in international testing like PISA. It also includes published empirical studies on teacher quality globally, focusing on studies in India on teacher variables termed *traditional* and *non-traditional*. The literature review examines new and older published articles, policy briefs, working papers, and newspaper articles that influence and shape the study on teacher quality.

The literature review is divided into three main sections. The first section examines the context. It includes background on 1) India as a diverse nation, 2) the Indian education system, including the states of Tamil Nadu and Himachal Pradesh, 3) teacher education in India (history and current scenario), and 4) an overview of the Indian education policies selected for the study. The second section reviews literature on both the traditional and non-traditional variables of teacher quality. The third section includes conceptual and theoretical frameworks and a summary of the frameworks.

Section I

India—A diverse nation. India is a prime example of "unity in diversity" with its multiple states, languages, religions, and cultures. While a rich cultural heritage is an outstanding characteristic of the country, social hierarchies due to the caste system, the widening gap between the rich and poor, and the gap between the educated "elite" and the uneducated are also an integral part of the society. The classification of schools between private and government is the result of the class inequalities, where only the privileged can afford to attend a "good education" system provided by private schools. Apart from such a classification affecting the education access, it affects the teacher quality as teachers in private schools may not be qualified

or certified from teacher education institutes under the government body NCERT (Singh & Sarkar, 2012).

Additionally, India has over 29[1] states with their own regional languages apart from the language Hindi, declared the official language in India after independence. The diversity of languages or multilingualism is a unique characteristic of the country and also a cause of concern in the education sector (Huisman, Rani, & Smits, 2010). Although Hindi is an official language, it is not a native language for many, and hence there is no one medium of instruction for the teacher. The teacher, apart from catering to diverse academic needs of her or his students, has an additional task of accounting for dialectic nuances that influence student learning (Gelda, Narayan, Mudiyam, Raturi, & Seshan, 2013). The three-language formula[2] adopted by the education sector in the country in 1957 is now being replaced by bilingualism with English and Hindi or English and a regional language as a medium of instruction. Therefore, the western influence is overtaking the language diversity in India, with English slowly becoming the dominant language of instruction in most parts of the country (Huisman et al., 2010). Unfortunately, hegemony by the English language is affecting the quality of education in the country, especially in the rural areas as natives are not familiar with the English language.

Furthermore, the NCF 2005 states that since the language used in mathematics textbooks is different from the language students use in their day-to-day living, it creates anxiety and fear in students. Therefore, it was recommended that the mathematics curriculum contain language that students use in their daily lives (NCERT, 2006). The policymakers also realized the

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[1] 22 languages have gained constitutional recognition in India.

[2] The three-language formula was adopted in 1957. In the first five years of schooling, a regional language is used as the first teaching language. During school years 6 to 8, a second language is taught as a school subject: Hindi in non-Hindi areas and another Indian language in the Hindi areas. From the third year onwards, English is taught as a school subject (Huisman et al., 2010).

importance of English as a necessary means for international communication. Therefore, teaching in English could not be completely shut down either. Thus, the country's diversity poses many challenges, especially to teachers.

The Indian education system. India, a country in Asia, is the home to over a billion people. Indeed, education has always been given a valuable place in Indian society and is considered a means to eliminate the vicious circle of poverty, thereby raising the country's productivity. In fact, the father of the Indian nation, Mahatma Gandhi, stressed the importance of education for both males and females as a source of developing a balanced human personality (Rani, 2010).

Classification of schools. According to a report in 2014 by The British Council, India on the Indian school education system:

> The Indian school education system is one of the largest and most complex in the world. The complexity of the system stems from India's need to maintain standards and uniformity, while giving scope for its diverse culture and heritage to grow and flourish across the length and breadth of the country. (p. 3)

Classification by level of education. The school system in India (see Figure 1) follows the levels of pre-primary, upper primary/middle, secondary, and higher secondary education. The Ministry of Human Resource Development governs the overall education system in the country alongside a Central Advisory Board on Education, with each state having its own Education Ministry (The British Council, India [BCI], 2014).

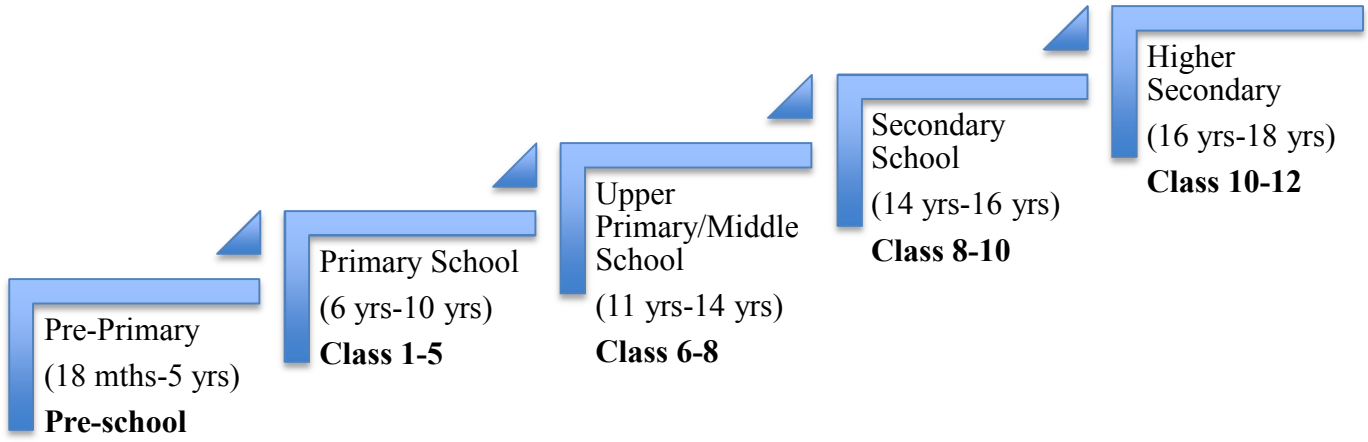

Figure 1. Indian education system. Reprinted from BCI (2014, p. 22).

Classification by ownership. Schools in India are owned either by the government (central, state, or local government bodies) or private entities (trusts, individuals, or societies). They are classified into three categories: 1) government schools run by state education departments where no fees are charged; 2) private aided schools where schools are managed by private bodies but funds (partially or fully) are received from the government; and 3) private schools unaided and not funded by the government, who survive by charging fees. The private unaided schools have their own fee structure based on the location and services provided (Singh & Sarkar, 2012).

Since the private unaided schools are not homogenous in the country, one can find some schools charging low fees while others catering to rich families have a high fee structure. The interesting point to note here, according to Singh and Sarkar (2012), is that the three school categories also fall under the recognized and unrecognized categories. The schools recognized or approved by the state government have to fulfill certain requirements under the state government regulations regarding teacher-pupil ratios, qualifications, etc. The unrecognized schools are not

affiliated to any board but still continue to run in the country, though the District Information System for Education (DISE) does not have data pertaining to such an unrecognized education sector.

***Classification by educational board affiliations*.** Education in India is under the control of NCERT. It is an apex organization selected by the government of India to maintain quality in education. NCERT provides support to schools and ensures enforcement of the education policies. It also supports and advises the Ministry of Education in maintaining the quality of school education and teacher education in India (Nirav, 2012).

Acknowledging the importance of improving the teacher quality, the government has set up a permanent body for the selection of teachers known as the NCTE. It conducts training and selection of teachers and provides certificates/degrees for teachers, known as a Bachelor of Education (B.Ed.) or Shastri education, which are essential for teachers seeking employment in schools (Nirav, 2012). However, the NCTE has failed to prevent entry of private and unrecognized institutions that provide training and certifications to teachers, and private schools readily employ such teachers (Nirav, 2012).

Although the curriculum in all schools in India is monitored or comes under the two main boards which are the Central Board of Secondary Education (CBSE) and the Indian Certificate of Secondary Education (ICSE), recruitment of teachers in private schools is solely at the schools' discretion. Therefore, the quality of teachers in both private and public schools in India differs substantially. According to a report in *The Times of India*, many teachers in private schools in the country do not have the requisite teaching B.Ed. degree, and a few of them have not even completed their high school education (Raghavan, 2013).

Thus, the Indian education system, which is vast and continuously changing, faces many challenges (BCI, 2014). Evidence shows that the number of private schools in India has been increasing since the 1990s due to demand for good education and lack of adequate facilities in the government schools (Huisman et al., 2010). However, since the private schools are not regulated by NCERT, the quality of teachers is questionable.

Within India, there were only two states that participated in the PISA 2009 tests. Since every state of India is unique, the following paragraphs briefly introduce the states of Tamil Nadu and Himachal Pradesh with respect to teacher quality.

Tamil Nadu. Situated in the southern part of India, the state of Tamil Nadu (TN) is geographically the 11th largest state in the country, occupying 4% of the national area (Gupta, 2012). Although a poor state, TN is one of the "better off" (Gupta, 2012, p. 1) states in the country in terms of literacy and student enrollment rates. Per Census 2001, TN had an overall literacy rate of 73% and female literacy rate of 65%. In terms of enrollment, the state has the highest enrollment in primary and upper primary education (Gupta, 2012).

The high enrollments are the results of various initiatives that the government of the state is providing and not due to the quality of education imparted (Duraisamya, Jamesb, Lanec, & Tanb, 1998). According to a study by Duraisamya et al. (1998), the government of the state provides free midday meals to every student in primary and middle school 365 days a year and also free uniforms and books to every child in the midday meal program. However, the high enrollments are leading to a skewed teacher-pupil ratio. Duraisamya et al. (1998) noted that between 1977 and 1992 the number of enrollments in schools across TN rose by about 139%, though the number of teachers increased by only 44%, affecting the learning of students. Lack of teachers is blamed on a poor salary scale and incentives.

TN primarily focuses on teacher qualification and in-service training to improve its teacher quality. Interestingly, according to Vaigaichelvan (2013), of the 625 teacher training institutions, 87% are private and unaided. On a national level, 90% of the teacher education institutions are private, and per NCFTE 2009, the rapid increase and privatization of teacher education is resulting in poor and sub-standard regulation of teacher education. Mathematics is taught by unqualified teachers or qualified teachers with no proper training (Ramachandran, Bhattacharjea, & Sheshagir, 2008).

The Sarva Shiksha Abhiyan (SSA) or literally the "Campaign for Universal Education," a flagship program by the Government of India initiated in 2000 for achieving universal elementary education, plays a major part in in-service training for teachers in TN (Kingdon, 2007). The objective of SSA is to keep teachers motivated and confident. However, a study by Ramachandran et al. (2008) finds that teachers are demotivated and stressed due to their non-involvement in the strategic planning of a program borrowed from the western culture, the Active-Based Learning (ABL) program.

Thus, the state of TN that participated in PISA 2009 has a high rate of literacy that is not the result of teacher quality. Also, unqualified and dissatisfied teachers, increased privatization of teacher education, and educational borrowing are issues resulting in poor teacher quality in the state. However, TN is mainly focusing on traditional measures of teacher qualification and in-service training to improve teacher quality.

Himachal Pradesh. The state of Himachal Pradesh (HP) is situated in the northern part of India in the Himalayas and is the 11th highest state in the country with respect to literacy. HP is a top state in the country for a low student-teacher ratio, far below the minimum required ratio of 30:1 as mandated by the Right to Education (RTE) Act. However, the quality of education is

low, and hence there is a flight of children from government to private schools as it is believed that education in private schools is better. The recent trend in the state is the increase in the number of schools, and the government of HP is consciously moving from a focus on access to quality of education (Wad, 2017). The state of HP is a unique example in India of high literacy rate, less gender bias, and less social discrimination in enrollment, and the gross enrollment ratio for boys and girls is 1:1. In an article, Wad (2017) states that although the school has adequate educational resources due to the state policy and assistance from the SSA, there is a lack of trained and qualified teachers. In addition, many teachers in schools are contract or part time teachers. This is negatively impacting the learning of students and education quality.

The situation in HP reinforces that teacher quality impacts students' learning and education quality. The government of HP is consciously consolidating existing schools rather than increasing the number of schools and recognizes the fact that consolidation of schools will be beneficial only if it is accompanied by an adequate supply of good teachers (Wad, 2017). However, like in the other states of India, "good" teacher is not defined, although it is connected to better outcomes (Wad, 2017).

The states of TN and HP, which are showcases of India's education and development in areas of literacy and enrollment, are looking at traditional qualities of teacher qualification and training in improving teacher quality (Duraisamya et al., 1998; Ramachandran et al., 2008) and yet teachers in many schools do not possess any kind of a college degree. In TN, there is an increase in private unaided teacher training institutions, leading to low teacher quality. In the state of HP, teachers are getting a B.Ed. degree within 8-10 months of joining the course (Lohumi, 2015).

Apart from there being an acute shortage of teacher training facilities, the programs are varied throughout the country. So how does India train its teachers? The next section gives an overview of the history of teacher education in India.

Teacher education in India.

History. In ancient India, education was largely religious, and the onus of teaching rested on the Brahmins.[3] There exist no records of any formal teacher training institutions although the relationship between a teacher and student was considered vital and sacred (Saxena, 2007). Teachers in that era were expected to possess characteristics of "piety, religiousness, illuminated vision, high character, self-confidence, sound judgment, awareness of his social duties, efficiency and self-restraint" (Saxena, 2007, p. 2). The "Gurukul" education, as it was called, was a system of education where whoever wanted to study went to the teacher or the "guru's" home to learn subjects like mathematics.

Around the eighteenth century when Europe gained world recognition due to its advancement in science, technology, and other subjects, the British felt the need to introduce English education in the country to bring in the modern education system and curriculum in India (Kumar, Dewan, & Subramaniam, 2008). This period also witnessed teacher education getting due attention.

The first teacher training institute in India was started in 1802 by Danish missionaries in West Bengal.[4] By the nineteenth century, the need for systematic teacher training institutions evolved in the metropolitan cities of Calcutta, Madras, and Bombay. The focus of these institutions was enhancing student knowledge for academic excellence with teaching

[3] In ancient India 600 BCE, Brahmins were considered the highest class in India (Saxena, 2007).
[4] West Bengal state is situated in the eastern part of India.

methodology ignored. In the year 1886, the first secondary teachers' training institute, called the Government Normal School, was established in Madras,[5] and between 1904 and 1912 further teacher training centers evolved with the passage of the Government of India's resolution calling for secondary school teachers to have a certificate of teaching. Thus, the concept of the traditional teacher measure of teacher quality evolved: qualification and teacher certification.

By the mid-1900s, the Hartog Committee recommended refresher courses and conferences for existing teachers to increase the quality of teachers in schools, giving rise to the concept of teacher training which in today's modern era is called the professional or in-service teacher training (Saxena, 2007.). By the year 1947, when India gained independence from British rule, there were many teacher training institutes that focused mainly on teacher variables that are defined as traditional measures in this study. Saxena (2007) in her study asserts that the importance of a teacher in a student's progress has been stressed in the Indian society since the Rig Vedic age,[6] and the country has always aspired and "inspired the presence of high quality teachers" (p. 27). Thus, India has a history of recognizing traits or variables that a good teacher should possess and the importance of teachers in a student's life.

Current scenario. Since the early 1900s, the teacher education system has also expanded, but rather unevenly. Most parts of the country have poor infrastructure to train teachers, and out of the 5 million teachers, only 80% receive some kind of formal teacher training (Kumar et al., 2008). Furthermore, student teachers get little practical experience due to a lack of infrastructure and professional expertise. Also, the curriculum and training given to student teachers does not provide them with insight on the practical applications of subjects like mathematics and science

[5] Madras is now called Chennai and is the capital city of the state of Tamil Nadu.
[6] 1500-500 BCE was when the Vedas or the oldest scriptures of the Hindu religion were composed.

(Kumar et al., 2008). The launching of the 2010 RTE Act shows there is a need to recruit trained teachers because more than 30 million children in India are still out of school. Additionally, the distinction between pre-service and in-service teacher training is blurred. In many schools (private and public), teachers without any training or qualifications are already employed in schools and are now expected to get the required diploma or training within a time specified by the 2010 RTE Act.

The Public Report on Basic Education (PROBE) (1999) in India found the following:

> Many teachers in our country have not had the benefit of a good pre-service training for their job. For most candidates who wish to be teachers, there is an acute dearth of good teacher-training facilities and the quality of training programs offered in the country is varied. Another problem is the content of the training course. For one thing, the content of the pre-service courses has not kept pace with changes in the field. Secondly, it is assumed that the higher a teacher's formal qualifications, the more suitable he or she is for the job. Thus, a B.A. (Bachelor of Arts) would be preferred over a class-12 candidate with a BTC (Basic Training Certificate). Again, if there was a tussle between a B.A., B.Ed. and an M.A. (Master of Arts), then the latter would automatically be taken. Ironically, neither the B.A. nor the M.A. has any special relevance to young children, and the B.Ed. is really a pre-service training for secondary school teaching. (p. 56)

The position paper of NCF 2005 on teacher curriculum highlights that a new teacher education program should be formulated for pre-primary, primary, secondary, higher secondary, and graduate levels, and it should be under a recognized university. Also, the teacher education program should be a five-year program after the 10 + 2 level of school education followed by the country. The program should contain core competencies that teachers at all levels from pre-

primary to graduate levels will follow before their choice of specialization. NCF 2005 also states that the teacher program should not be created in isolation but should be connected to the school curriculum, considering the regional context of the school's location. Finally, the position paper highlights that the teacher program should have a provision for linking the pre- and post-training of teachers through the District Institute of Education and Training (DIET) within university-based institutions (NCERT, 2005).

Sadly, in practice today, there is little focus on the quality of teachers. The Teachers Curriculum framed by NCTE in 2006 (as cited in Naik, 2008) shows the lack of professional development for teachers in India with little concern for preparing teachers for constantly demanding and fluid classroom situations. The other issue that the Indian education system is facing is a high pupil-teacher ratio due to an acute shortage of teachers. Therefore, to enhance teacher quality, India also needs to look at teacher absenteeism and take adequate measures. Kohli (2015) reports that in a few government schools in New Delhi, students are taught in corridors due to lack of space, and there are teachers who are absent for 40% of the working days.

Summary of teacher education in India and its relevance to the study. Teacher education in the country is an old concept, and yet the quality of teachers in the country leaves much to be desired. There has been much focus on traditional teacher variables like teacher qualification and professional development and training since the early 1900s. However, the current scenario of teacher education in the country shows lack of quality teachers and needs to focus on other teacher variables to improve the teacher quality. The history of teacher education and current scenario reconfirm the necessity of this study to move the focus of policymakers

from traditional teacher quality measures tied to teacher education institutions in the country to non-traditional teacher quality variables to improve teacher quality in India.

To discover how education policies support or do not support certain teacher quality variables or measures, the next heading focuses on an overview of the policies chosen for the study.

Overview of Indian education policies. The Executive Committee of NCERT in India made a decision in 2004 to revise the existing (2000) National Curriculum Framework to create a balanced national education system. The decision came in light of the repeated concerns over the quality of learning and the unnecessary academic pressure on school going children (Pal, 1993). The low quality of education imparted was reflected in the low scores in literacy and numeracy assessment on Trends in International Mathematics and Science Study (TIMSS) 2007.

Prior to the report, there were several recommendations made over the past two decades by several committees, including the Ishwarbhai Patel Review Committee (1977) and the NCERT Working Group (1984), to improve the quality of learning for young children in India. The curriculum development agencies implemented the recommendations more specifically, however, when the new curriculum was introduced by the National Policy on Education (NPE) in 1986 (Pal, 1993). Therefore, the NPE (1986) proposed a new curriculum framework to evolve a better quality and child-centered national system of education, which was called the NCF, in 2005.

NCERT is responsible for reviewing and formulating the curriculum at regular intervals, considering the fact that a national curriculum cannot be a static document but should be revised regularly to reflect the dynamism and diversity of society, reflected in schools (NCERT, 2010). Therefore, the NCF 2005 is a result of revisions made to NCF 1975, 1988, and 2000 by the

NCERT in consultation with the National Steering Committee, 21 focus groups, and the position papers prepared by these groups (Yadav, 2013).

The NCF 2005 aims to prepare every child in the country to grow in India's fast-changing position in the world and global economy (NCERT, 2005), and for this, it focuses on remodeling the teacher education to make learning more relevant for the child in today's global economy. The NCF 2005 model works on the principle that if the method of teaching is relevant to the child, it will positively impact both teacher quality and student learning.

NCFTE 2009 developed by the NCTE gives a systematic and comprehensive framework for teacher education. The NCFTE 2009 views teaching as a profession that requires a well-planned and relevant education program and training like any other profession. NCFTE's vision is to make the teacher educational institutions centers of research and practical training to improve teacher education and quality in the country (NCTE, 2010).

A recent addition to the education policies in India is a draft of the NPE 2016 by the Government of India, which mainly targets improving quality of education at all levels by focusing on an incomplete agenda of previous policies and current education sector-related challenges (Government of India MHRD, 2016a).

The national policies chosen in the study consider different ways to improve teacher quality. Therefore, an in-depth analysis of them shows which teacher quality variables or measures are a focus of the policies in India.

Summary of Section I. In traditional Indian society, class structure permitted only the higher class, or the Brahmins, to be "qualified" teachers. The Scheduled castes, Scheduled tribes, and women were not permitted to possess formal education, thus segregating the population between the educated and the uneducated. In modern times, the repercussions of the class

structure are visible in the current situation of teacher quality. Classification of schools between the government and private unaided schools has led to variation in teacher quality in the country. Although India has teacher education institutes managed by NCERT and Section 23 of the RTE Act mandates all teachers employed in government schools possess the minimum qualifications laid down by the NCTE, the requirements are not mandatory for private unaided schools (Government of India MHRD, 2016a). However, since the private sector is expanding in the country (Kingdon, 2006), there is now a flood of poor quality teachers.

Additionally, in India, the formulation of policies since 1968 focuses on teacher quality to improve quality of Indian education. The number of teacher education institutions and training centers is increasing (Kumar et al., 2008), and the NCF 2005 has revised various components including teacher education in the country. However, the student performance is low compared to international standards. This leads to the first research question which analyzes the main Indian education policies to see how they support the various teacher characteristics.

Section II

This section reviews literature on the traditional and the non-traditional measures or characteristics of teacher quality with respect to student performance as selected in the study.

Teacher quality measures. The study now explores the relationship between the selected traditional teacher quality variables of teacher qualification, teacher certification, and professional development.

***Traditional teacher quality measures*.** Teacher quality is an abstract term as there is no specific way to define it. However, teacher quality has been associated with many variables or traditional characteristics (Goe & Stickler, 2008). Policymakers continue to use traditional teacher qualities of teacher qualification, teacher certification, and professional development as

proxies for teacher quality. This study presents these traditional teacher quality measures associated with student achievement.

Teacher qualification. Teacher qualification, characterized as a traditional teacher quality, is measurable. There is no universal teacher qualification requirement, however, and it varies from country to country based on its education policy. In India, teacher qualification is identified with a graduate (B.Ed.) or a postgraduate (M.Ed.) degree in order to teach mathematics (NCTE, 2010). In the United States, one needs to have a bachelor's degree to enter the profession, and teachers who teach mathematics to middle or high school students need to be highly qualified in mathematics per the NCLB Act of 2001 (Akiba et al., 2007; Ingersoll, 2007).

There are several studies that have found an association between student achievement in mathematics and teacher qualification if the qualification is content related. Akiba et al. (2007), in a cross-national study on teacher quality, found that students whose teachers are certified in mathematics, have three or more years of experience teaching mathematics, and are also mathematics-major holders positively impact student outcomes as compared to teachers qualified in subjects other than mathematics. Similarly, a study by Lee and Zuze (2011) in Sub-Saharan Africa demonstrated that mathematics achievement is typically higher for students whose teachers have stronger academic and professional qualifications in the subject matter. The study revealed that some schools in Sub-Saharan African countries like Botswana, where the quality of teachers in terms of qualification and experience is high, score better in mathematics than students in schools in Malawi where teacher qualification is low. In South Africa, a country still facing the consequences of the apartheid regime, evidence shows that learning outcomes for students are on the rise after schools were able to retain qualified mathematics teachers (Van der Berg & Louw, 2007). It is argued that a qualified teacher shifts her or his role from being simply

an evaluator to a facilitator and guide who allows students to think about and analyze their own work (Hill, Rowan, & Ball, 2005).

Evidence in support of teacher qualification in India varies. A study by Kingdon (2006) revealed that, although minimal, a teacher with a master's degree or above can raise student outcomes. In India, many schools realize the significance of qualified teachers with respect to student learning and are trying to attract and retain qualified teachers through incentives (Muralidharan & Sundararaman, 2011).

Within India there are also studies that show diverse results between government and private schools in respect to teacher qualification and student achievement in mathematics. A study by Singh and Sarkar (2012) in the state of Andhra Pradesh showed that mathematics teachers in government schools have on average three years or more experience than mathematics teachers in private schools. Additionally, the study further revealed that, for mathematics teachers, there is a far larger percentage of teachers in government schools that hold a diploma, bachelor's, or master's degree as compared to private schools. However, the number of bachelor's and master's degrees held by teachers in areas other than teaching is higher in private schools. Evidence in the study showed that students' mathematics scores are higher in private schools than in government schools. The question then arises as to why learning outcomes are higher in private schools when there are better qualified and experienced teachers in government schools. The authors reiterated that just having a general B.Ed. or M.Ed. is not sufficient to impact student mathematics performance.

Teacher certification. Teacher certification for this study is defined as a teaching certification by an authorized institution in the country. The topic of teacher certification impacts on student achievement is quite limited both in India and outside the country. The few studies

available (Darling-Hammond, 2000; Goldhaber & Anthony, 2003) argue that teacher certification is associated with student gains. Darling-Hammond (2000) conducted a state level analysis using data from the United States to examine the relationship between certification status and student achievement on the National Assessment of Educational Progress (NAEP). This study revealed that certification status is an important determinant of student outcomes.

In contrast, Ballou and Podgursky (2000) stated that there is no association between teacher certification and student achievement in mathematics. The researchers commented that certification in fact prevents bright and capable people from entering the teaching profession. Later, Pugath (2017) asserted that developing countries are giving priority to teacher certification and spending substantial resources in certifying teachers. However, Pugath (2017) said that evidence in Gambia, Chile, and Indonesia shows little or no association between teacher certification and student outcomes. Pugath (2017) argued that while in the United States a master's degree distinguishes between a certified and uncertified teacher, in most developing countries a teaching certificate is a part of an undergraduate degree and, therefore, certification in developed and developing countries differs in impacting student learning.

Acknowledging teacher certification being associated with student gains, Goldhaber and Brewer (2000) conducted a study to examine which type of certification (standard, private school, emergency certification, not certified in subject area) impacts student performance in mathematics. The study revealed "evidence in math that teachers with subject-specific training (a mathematics degree or certification) outperform those without subject-matter preparation" (p. 141).

In India, the NCTE determines the qualifications required by teachers, while the certification, which is a relatively new concept in India, is handled by the Centre for Teacher

Accreditation (CENTA). From the limited information available, existing teachers are certified by CENTA based on their years of experience. However, certified teachers without teacher qualifications can only teach in private, unaided, pre-primary schools in India (Centre for Teacher Accreditation [CENTA], n.d.). There were no evidence-based studies available showing that teacher certification impacts student outcomes in India.

Professional development. Professional training considered for the study includes teacher in-service training and participation in different activities enhancing teacher knowledge and skills. In India, the NCTE, a statutory body of the Central Government, is responsible for pre-service teacher training through a planned and coordinated development of teacher education in the country. The in-service training is provided by various teacher training institutions (TTIs), unaided schools, and other establishments (Government of India MHRD, 2017).

On professional development, Garet, Porter, Desimone, Birman and Yoon (2001) concluded that teacher professional development is a major focus of a "[systematic] teacher reform initiative" (p. 916). The study stated that professional development for teachers is most effective in improving student performance when it is "ongoing, sustained and intense" (p. 916) rather than short term. Therefore, the duration of the professional development has important impacts on student outcomes. The study also revealed that professional development influences student outcomes when it is hands-on, embedded within the curriculum, and active with school goals.

A report by Wenglinsky (2002) stated that students whose teachers receive professional development perform better than students whose teachers do not receive any professional development, especially in mathematics, where there was a difference of one full grade. A study in the United States conducted on the effect of a three-year long professional development

program on mathematics showed professional development impacts teachers' content knowledge and teaching practices, thus significantly impacting student achievement (Polly et al., 2015).

However, a study in eight Latin American countries showed that on average there is no impact of teacher professional development on student learning, and formal education or pre-service training is more effective than in-service training (Velez, Schiefelbein, & Valenzuela, 1993). A study by Hanushek and Luque (2003) in the United States showed no impact on student performance due to any kind of specialized training in mathematics by the teachers.

In contrast, Stewart (2010), in her article commenting on the education systems of the United Kingdom, Singapore, China, the United States, Canada, Japan, and Finland asserted that "regular professional development is essential for effective teaching and learning" (p. 19). She believes that countries such as the United States provide incoherent and inconsistent professional development opportunities for their teachers.

In India in a study conducted using administrative data from private schools, Azam and Kingdon (2014) showed that there is no association between teacher in-service training and student achievement and that there is unnecessary emphasis on teacher in-service training by policymakers in the country. However, a study in rural India showed that students benefit from professional teacher training in their classroom knowledge and skills, though it reported that the training was not conducted per the norms of the NCTE with respect to content and implementation of practices (Kidwai et al., 2013).

Summary of literature on traditional teacher quality measures. With respect to teacher qualification in India, evidence from the literature shows that it has a positive impact on student outcomes in mathematics, if the degree is in mathematics. Having a bachelor's or a master's degree in a subject other than mathematics does not impact student outcomes. This view holds

true even in the United States. With respect to teacher certification, there were no studies available in India. Internationally, the evidence is mixed. While some studies show that teacher certification has an impact on student outcomes, others show no association between the two. In the United States, it is evident that certification matters provided it is subject specific and not a general certification. With respect to professional development, conflicting results show that research does not support the view that teacher training will increase teacher quality or student outcomes, but it also does not state that training is unimportant. The study concluded that training by itself may not prove beneficial to student outcomes.

Non-traditional teacher quality measures. The study now explores the relationship between the selected non-traditional teacher quality variables of teacher salary and performance pay, teacher absenteeism, teacher qualified in mathematics, teacher attitude, and student achievement in mathematics.

Teacher salary and monetary incentives. In India, the salary of teachers employed by private schools is "negotiable" at the entry level (Jain & Kabra, 2015), and private schools may opt for the salary bands suggested by the Pay Commission. The salary or incentives for teachers employed in government schools is determined on the recommendations of the Pay Commission with an annual increase of 2.5%. The basic salary in government schools is based on qualification and years of experience.

There are limited studies on the association of teacher salary/performance pay/any monetary incentives and student achievement. In the United States, the results on teacher salary and monetary incentives are mixed. Figlio and Kenny in 2007 conducted a study showing that students' test scores are higher in schools where teachers are given individual financial incentives; however, statistical evidence to prove a positive correlation between teacher merit-

pay and student outcomes in mathematics was limited. Others state there is no association between monetary incentives and student outcomes (Fryer, 2008)

For India, Kingdon and Teal (2007) asserted that pay structure is an important tool in the hands of the policymakers and supported this in their study involving private and government schools there. They found that although the merit-pay incentive works well in private schools, it fails to impact the results in government schools. Kingdon and Teal (2007) concluded that higher salaries motivate teachers to work harder in government schools.

Muralidharan and Sundararaman (2011) recommended monetary incentives in the form of performance pay to teachers to improve student learning. They conducted a study in a few government schools in the state of Andhra Pradesh where teachers were given bonus payments based on student achievement. The study found that "students scored significantly higher on conceptual and mechanical components of the assessments revealing that student learning improved in math versus students in schools with other school-based inputs of a similar value to the teacher performance pay" (p. 1). The study argued that monetary incentives are a great motivator not only to retain teachers but to improve their quality and student performance. Additionally, such incentives encourage teachers to be more committed, especially in a country like India where the pay scales are low in comparison to the international standards.

To study the long-term impact of performance pay on student outcomes, the study by Muralidharan and Sundararaman in 2011 was extended for three years. The study found that although individual teacher incentive programs continued to enhance student outcomes not only in mathematics but also in other subjects, group teacher incentives that worked in the initial two years of the experiment gradually ceased to impact student outcomes. The researchers, some of the few who have conducted a study on performance pay in India, concluded that teacher

incentives are three times more effective in raising student test scores than other school related inputs.

Although the studies conducted are few in India, evidence shows a positive association between performance pay and student outcomes in mathematics, other factors remaining constant. In other developing countries like Israel (Lavy, 2002), performance pay and high salaries are associated with student performance. Similarly, a study conducted in Kenya reveals that increases in salary and monetary benefits show positive impact on student outcomes as teachers are motivated, and therefore, they perform more effectively (Akello, 2015).

Teacher absenteeism. Studies have shown absenteeism lowers student performance in mathematics and is also an economic concern for schools. In respect to student performance, evidence shows that the more days a teacher is absent or out of the classroom, the more negatively it affects student performance (Finlayson, 2009; Miller, 2012; Porres, 2016). Finlayson (2009) studied the effect of third-grade teacher absenteeism on third-grade students' performance on the Criterion Reference Competency Test (CRCT) to show how teachers' absenteeism affects students' outcomes including in mathematics, which requires daily teacher supervision, input, and practice. She found that in Cobb County, Georgia, United States, teachers were absent an average of ten days a year, significantly reducing student scores.

In a study conducted in New Jersey, United States, Miller, Murmane, and Willett (2008) reported that on average 40% of teachers are absent each day. Evidence from her study showed teacher absenteeism to be an important indicator of student outcomes in mathematics. In the study, Miller et al. stated, "Every 10 absences lowers average mathematics achievement equivalent to the difference between having a novice teacher and one with a bit more experience" (p. 5). Miller et al.'s study (2008) further found that teachers remained absent less if

they had to notify the management or principal of the school by telephone. To reduce teacher absenteeism and the negative impact on student scores, Boyer (1994) recommended paying teachers for unused sick leave.

Often teachers are within the school premises but absent from the classroom as they are attending professional development workshops during school hours. This also negatively impacts student learning (Miller, 2012).

Teachers from low socio-economic areas tend to be absent more often than those at other schools (Kremer, Chaudhury, Rogers, Muralidhran, & Hammer, 2005; Miller, 2012; Nedungadi, Mulki, & Raman, 2017). In a study conducted in six countries across three continents, Kremer et al. (2005) found that India had the highest absence rate compared to Bangladesh, Uganda, Peru, Indonesia, and Ecuador. Conducting their study in government schools in rural areas of the states of Maharashtra (Western India) and Jharkhand (Northern India), researchers found that 25% of teachers were absent during the team's unannounced visit to the schools.

Evidence from the literature review on teacher absenteeism takes a clear and logical stand that when teachers are absent or out of the classroom, a student's outcome is negatively impacted. In India, teacher absenteeism is high, thus affecting students' performance.

Teachers' subject-matter knowledge. In the United States, studies show that a teacher's subject knowledge, especially in mathematics, positively impacts student achievement (Goldhaber & Brewer, 1997, 2000; Hill, Rowan, & Ball, 2005; Monk, 1994; Rowan, Chiang, & Miller, 1997; Wenglinsky, 2002). Studies reveal that students whose teachers have a master's or bachelor's degree in mathematics have the highest test scores as compared to students whose teachers have a master's or bachelor's degree in other subjects but teach mathematics (Goldhaber & Brewer, 2000). Kennedy (1997) argued that mathematics is a subject in which teachers

themselves need to have a deep understanding of the concepts and procedures so as to encourage students to explore the subject without any fear.

Although studies consistently support the fact that subject-matter knowledge in mathematics is important to increase student outcomes, subject-matter knowledge is measured differently. In the United States, Goldhaber and Brewer (2000) measured subject-matter knowledge of mathematics with a master's or a bachelor's degree in mathematics. Similarly, Rowan, Chiang, and Miller (1997) measured subject knowledge in terms of whether the teacher had a mathematics degree at the bachelor's or undergraduate level and whether the teacher could answer a mathematics quiz in a teacher survey. Studies convey that the association is logical, as to teach a subject like mathematics, expertise in it is essential.

Studies in developing countries also show a positive relationship between a teacher's subject knowledge and student outcomes. A study conducted in five countries (South Africa, Botswana, Mozambique, Tanzania, and Namibia) using the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) II data revealed that teacher content knowledge plays a big role in impacting student outcomes. However, it was not clear from the study how content knowledge was measured (Spreen & Fancsali, 2005). Similar results were found in a study conducted in Thailand on eighth-grade mathematics students in a few Thai schools using multi-level modeling (Lockheed & Longford, 1989). The study affirmed that subject knowledge of the teacher is critical to student learning and that a mathematics teacher has to be qualified in mathematics. However, the study did not define the term "qualified in mathematics."

Teacher attitude. Teacher attitude for this study includes student and teacher rapport and classroom environment. Teacher attitude is increasingly important, especially in light of the

recurring problem of how to improve enthusiasm and student mathematics scores for the subject. Realizing the importance of teacher attitude on student outcomes, it is not surprising that there are many studies focusing on this teacher quality measure.

Studies from the United States reveal that in the absence of a teacher's positive demeanor and encouragement, students face mathematics difficulties, thus leading to poor performance (Lattimore, 2005). Therefore, most studies in the United States conclude that a positive attitude displayed by a teacher can help reduce mathematics phobia or anxiety in students, resulting in improved test scores (Ashcraft, 2002; Lattimore, 2005; Opdenakker & Damme, 2007).

With respect to mathematics, studies show that teachers who project a feeling of trust in their students' ability to do mathematics communicate confidence in the pupils' future performance, leading to a positive growth in mathematics learning (Lee & Loeb, 2000). During mathematics instruction, a positive reaction by a teacher rather than a neutral response facilitates student learning because it encourages students to participate in class discussions (Centra & Potter, 1980). Also, a teacher's attitude about teaching mathematics to her or his children comes across clearly in the teaching methods. A teacher who has a positive attitude towards her or his students and mathematics will facilitate knowledge building in mathematics through an exploratory process, thus enabling students to grasp the conceptual knowledge of the subject and achieve high test scores (Lattimore, 2005).

In respect to student-teacher relationships, studies from the United States reveal that a positive teacher's attitude also helps develop a strong rapport between a teacher and student, impacting student outcomes in mathematics (Downey, 2008; Gallagher, Kainz, Feagans, & White, 2013). Gallagher et al. (2013) further added that apart from academic gains from a positive teacher-student relationship, there are social gains too: students feel motivated to work

and also communicate better with their teachers, thus reducing the number of high school dropouts.

In India, most studies on teacher attitude focus on college level students. However, evidence, though limited, shows that teachers in schools in Rajasthan (Northern India) and Orissa (Eastern India) who have a positive attitude towards the learning of their students and show a positive attitude towards additional training have improved student performance (Wu, Goldschmidt, Boscardin, & Sankar, 2009).

Summary of literature on non-traditional teacher quality measures. In India, evidence from an extensive five-year study showed that teacher performance pay is a motivator for teachers. The salary structure for teachers in India is comparatively low, and, therefore, performance pay acts as an incentive for teachers to increase the quality and time spent on teaching students to improve their performance. However, in the United States, the results are mixed. While few studies show the positive relationship between teacher merit or performance pay and student outcomes, there are other studies that show that there is no association between the two.

Globally, teacher absenteeism has been shown to negatively impact student performance as there is discontinuation of instruction, practice, and classroom routine (Miller et al., 2008). In respect to subject-matter knowledge, evidence from studies globally shows that there is a positive relationship between teachers' subject-matter knowledge in mathematics and students' performance in the subject. The logic is that if a teacher has a thorough knowledge of mathematics, she/he will be in a better position to explain the content well. However, the main drawback in studies relating to subject-matter competency is that teachers' competency in mathematics knowledge is not measured consistently across countries.

Teacher attitude is an important factor impacting student's performance. A teacher with a positive attitude has a "student-centered" approach to her or his teaching, instilling confidence in students to approach a complex subject like mathematics for which many possess mathematics phobia or anxiety. In comparison, research has shown that a teacher with a negative attitude and "teacher-centered" instruction adversely impacts student performance (Manswell Butty, 2001).

Findings from Literature Review

First, the literature review sheds light on how the socio-economic characteristics of India, like the class inequality and language diversity, are challenges that teachers face. In the pre-British regime, education was religious with only a selected class called the Brahmins able to informally teach students, and there were no formal teacher training institutions. The concept of teacher training and education was the influence of the British regime. The poor student performance in PISA 2009 resulted in the country blaming the teacher quality. The policymakers are looking at reforms and new ways to improve teacher quality in the country. Since the concept of teacher quality is abstract, policymakers are focusing on a few teacher qualities or characteristics, termed the traditional characteristics (Goe & Stickler, 2008).

Second, in respect to the traditional teacher quality characteristics of teacher qualification, teacher certification, and teacher professional development, evidence in India and other countries shows mixed results for individual characteristics. However, the strongest evidence exists for the teacher quality measure of teacher qualification, provided the degree is in mathematics. Evidence in India with respect to teacher certification is missing, and, therefore, it is not clear the impact of teacher certification on student performance in mathematics. The literature review does highlight the importance of professional development on teacher

pedagogy, though much research is still needed to study the statistical impact on student performance.

Third, with respect to the measure of teacher salary and monetary incentives, results differ between developed and developing countries. In India, performance pay is a strong motivator for teachers and is reflected in the high mathematics scores. Evidence of the relationship between teacher subject-matter knowledge in mathematics and student performance is the strongest as studies show a positive correlation between the two. Overall studies reveal a strong association between teacher attitude and student performance, as students are motivated to perform well with a teacher who has a positive attitude.

Fourth, teacher absenteeism is a big issue in India and negatively impacts students' performance as revealed in the studies. Teacher absenteeism reduces the opportunities for children to learn and is a greater problem in a developing country like India, which has a high teacher absenteeism rate (Kremer et al., 2005).

Thus, the literature review shows how the various measures of teacher quality impact student achievement. The literature review does not support any one category of teacher quality measure over the others. For example, although evidence shows the importance of teacher qualification to improve teacher quality, subject-matter knowledge or a degree in mathematics is an added requirement. Similarly, teacher certification by itself has no impact on student outcomes in mathematics unless the certification is in mathematics. Therefore, the literature review supports the argument of the study that there are variables other than the traditional teacher quality variables, which are the non-traditional variables, that also impact teacher quality and are largely ignored by policymakers.

Section III

Conceptual framework. The study uses an adapted version of Hanushek's Education Production Function model to explain the linear and direct relationship between resources as inputs and their outcomes. The Education Production Function shows common inputs like school resources, teacher quality, and family attributes, with the outcome being student achievement (Hanushek, 2007). The inputs are easily measured and manipulated to get the desired output. The fundamental assumption governing the input-output model used in this study is that to achieve maximum output, here student performance in mathematics, policymakers should focus on the input teacher quality.

The model in Figure 2 offers a visual depiction of the relationships between the variables included in the study. The diagram shows the direct relationship between teacher quality variables (a school factor) and student outcomes in mathematics, a subject that nations across the globe consider a requirement for enhancing their education systems (Wiseman & Al-bakr, 2013). The intrinsic variable denotes the students from the two states that participated in the testing. The variables differ in their performance in the testing. The model is applied to the context of India.

First, since teacher quality is an abstract term and the study has chosen traditional and non-traditional measures to define it, the arrow from the school factor that is teacher quality shows a direct relationship to the intrinsic variable, which is the students, and their achievement in mathematics—the outcome. The conceptual framework, which follows, presents the two theories, given in Figure 2's circles, explaining why and how India is focusing on teacher quality as a resource to improve student outcomes internally and internationally.

Since human capital is the model India is adopting while focusing on teacher quality to improve student outcomes and the education quality in India, RQ1a and RQ1b analyze key

education policies in India to reveal whether the traditional or non-traditional teacher variables have been supported or not supported by them.

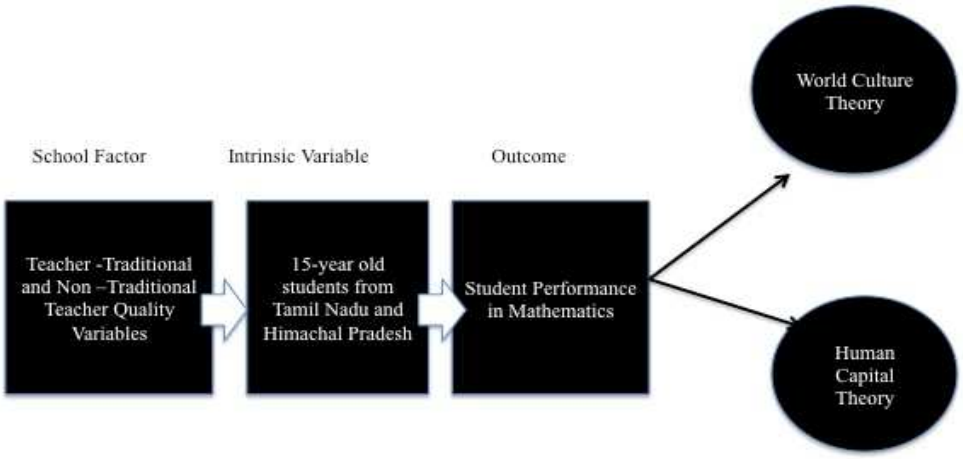

Figure 2. Visual diagram applied to the Indian context showing the relationship between teacher quality variables, students, and performance in mathematics. School Factor for this study includes only teacher quality. Adapted from Hanushek's Education Production Function Model (2007).

Next, the world culture theory shows how India is adopting a shared model to improve teacher quality. Therefore, finding out which set of teacher quality variables maximize the outcomes of students in mathematics is the essence of the study, as shown in RQ2a, RQ2b, and RQ2c, where the traditional and non-traditional variables are analyzed.

Theoretical framework. A strong theoretical foundation is essential for any research study and the scope of the research indicates which theory is the best fit. The research here

shows two main lenses through which to understand why India is focusing on teacher quality to enhance student performance. However, the research is not merely stating the existing theories but rather arguing how both complement each other and give a "bigger picture" of the research topic.

The first lens is human capital theory with human capital defined as a set of skills and characteristics that enhance human productivity (Mincer, 1981). The second lens is world culture theory which uses culture, or the "social[ly] shared symbolic and meaning systems that become embedded in objects, organizations, and people" (Lechner & Boli, 2005, p. 12), as its perspective for analysis. Both theories though separate are important in understanding India's focus on teacher quality to improve student outcomes and in answering the research questions.

***Human capital theory*.** Human capital, works as a key stimulus to promote a country's economic growth. The human capital model being discussed was created by Jacob Mincer (1981) who formulated it based on the principle that investment in education leads to a future return on capital. The theory proposes that human capital in the form of human capabilities enhanced through education and training not only enhances personal economic growth but also the economic growth of a nation. Mincer's model of human capital divides individual skills into two categories: skills that are inherited and skills that are acquired. He focuses on acquired skills, noting that they differ over time between countries and are the result of education, training, experience, and mobility.

Human capital theory asserts that the acquisition of such skills incurs costs and benefits: the former are either direct or indirect and the latter are either private or public (Mincer, 1981, p. 3). The theory argues that the benefits of costs incurred on acquisition of skills are durable and not immediate, representing an investment in human capacity. Just like any other investment,

Mincer argues that health issues or a skill becoming obsolete can result in the depreciation of a primary asset: human capital. The human capital theory advises developing countries to invest in health and education among other sectors to enhance that country's human capital and thereby its economic development. As Quiggin (1999) states, "in the 'human capital' model, education is an investment that produces benefits in the future. Recent cuts in education spending will therefore reduce future national income" (p. 3). The human capital model embraced by this study, however, does not take into account the fact that learning need not always lead to higher monetary returns but can simply lead to a higher base of knowledge.

India is one of the fast-developing economies, but the low quality of education in the country is hampering growth of its global excellence (Dhawan, 2014). The low quality of knowledge and skills imparted in schools is giving rise to unemployment in the society. The resulting talent shortage is thus limiting corporate growth and the economic growth of the country. India recognizes that success of any enterprise is largely dependent on its human capital and not just on its infrastructure. Therefore, the government recognizes that building human capital through education is a key stimulus of its economic growth (Sarkar, Rao, & Naik, 2008) and, given the importance of a quality teacher in enhancing student performance, is focusing on teacher human capital.

The teachers' human capital is articulated as a focus on developing a stronger teacher workforce that has the capabilities, skills, and knowledge to positively impact student outcomes, and this is referred to as investment in "human capital" (Dhawan, 2014). The human capital model used in this study works on the principle that investment in education brings returns for the future that include individual economic growth at a micro level and the country's economic growth at a macro level (Mincer, 1981; Quiggin, 1999). As the teacher quality improves by

investing in teachers' human capital, it will positively impact student skills and knowledge. Thus, the graduation rate in schools and colleges will improve, resulting in a stronger talent force. As Mincer (1981) states, "Schooling improves the efficiency with which people can absorb learning on the job, leading to greater job investments" (p. 10). The accumulation of individual human capital through quality education will lead to higher employment opportunities. As local and international corporations provide such opportunities, economic growth for the individuals and the country will result (Mincer, 1981).

Research by Sarkar et al. (2008) revealed that such economic growth for India depends on its ability to revamp its educational sector, which is facing issues of equity and quality. The researchers further added that to improve India's education system, investment in a capable and quality teacher workforce is a way to increase student outcomes and develop a future globally competitive and skilled workforce. Because of the costs associated to improve teacher quality, policymakers need to be aware of the appropriate areas to make the investments.

Applying and adapting the theory to this study, teachers' human capital in India is the knowledge, skills, attitude, motivation, and other measures or variables, both traditional and non-traditional, which have the potential to increase teacher quality and, in return, student skills and knowledge. Therefore, teachers' human capital can be increased by focusing on the appropriate teacher quality measures determined by the study to positively relate to student outcomes in mathematics. Over the years, the national policies in India have been reformed to account for changes in the education sector in India including teacher characteristics. The in-depth analysis of the three national education policies answers the first set of research questions on how Indian policymakers are addressing teacher human capital in terms of their focus on traditional and non-traditional teacher quality variables.

World culture theory. Neo-institutionalism, particularly world culture theory, provides a theoretical framework that explains India's participation in PISA testing and the significance of the research here in analyzing the influence of teacher quality variables on student performance.

The world culture theory holds that shared norms, values, and ideals (also termed *script*s) are now embedded in nations around the world as part of a world culture (Lechner & Boli, 2005). Lechner and Boli (2005) describe this rise of world culture around the globe as no longer being defined in European terms. Instead, they assert that "scholars agree that the rise of world culture is an outcome of globalization; as the world becomes more intimately connected in complex ways, growing links are given meaningful forms" (p. 438).

Globally shared values or norms, bounded rationality, and loose coupling are three characteristics of world culture. Lechner and Boli (2005) further explain that there is a worldwide culture embedded in organizations, technical structures, formalized rules, and constitutional documents in nations worldwide and that these norms and knowledge are shared across national boundaries by individuals, organizations, and corporations. Globally shared values or common scripts consist of a "systematic body of rules and principles, implemented by an ever-expanding set of institutions" that get adopted by individuals and organizations (Lechner & Boli, 2005, p. 12). These values or scripts may be widely-diffused but become so ingrained in society that they become taken for granted and unquestioned, eventually developing into societal expectations. Wiseman, Astiz, and Baker (2014) state that this adoption of common scripts or norms is legitimacy-seeking by nation-states to gain or maintain status at the international level.

However, "local variations and departures from standard models occur, in response to local circumstance and conditions" (Lechner & Boli, 2005, p. 15) which contribute to the creation of a bounded rationality. Discrepancies between policies made at the local and national

levels are what is referred to as loose coupling. Thus, world culture provides a foundation of similarity in values and guiding ideas across nations—these might be thought of as blueprints or scripts that the world culture values and people, therefore, view as rational (Lechner & Boli, 2005).

Institutionalized systems of education can be seen to display many characteristics espoused by world culture theory. According to the Universal Declaration of Human Rights, education was officially labeled as a human right in 1948, thus contributing to its evolution to a globally shared value, where all nation-states must provide, at a minimum, primary education for citizens as a way of being recognized as legitimate by other nation-states. Additionally, education systems exist within a bounded rationality of a generally accepted model to follow, consisting, for example, of a teacher, students, curriculum, and an organizational structure where students progress from one grade or level to the next. Finally, educational systems experience loose coupling in that policies made at the national level generally lose some of their intention by the time they are implemented at the local level.

Applying the main characteristics of world culture theory to the research here, we can first note that PISA testing commenced in 2003, and the next testing was in 2006. India did not participate in PISA 2003 or PISA 2006, instead participating for the first time in 2009. Overall, the number of countries participating in the testing increased from 49 in 2003 to 57 in 2006 and 65 in 2009, as they gradually embraced a world culture of education. India is culturally, socially, and economically different from most of the countries participating in PISA. However, India too is embracing a world culture of education by competing in international tests like the PISA 2009 to seek a legitimate standing at the global level.

Next, given the shared norms, values, and ideals that make up this world culture, the expectation is that many similarities exist between the educational systems globally and locally. In this research we can see this in the global acceptance that to improve education quality, teacher quality is used as a measure. Across the globe, there are also similarities in the conceptions of high teacher quality, leading to a degree of homogenization although there is no standard way to define teacher quality. The classification of teacher variables such as teacher qualification, teacher certification, and professional development is recognized by research globally. For example, in India, there is focus on teacher qualification to improve teacher quality (NCERT 2006), as is also the case in the United States where government regulations[7] prevail at many levels for highly qualified teachers (Ingersoll, 2007).

PISA assessments have thus resulted in countries competing with each other to gain a global standing in core subjects of mathematics, science, and reading. Meyer, Boli, Thomas, and Ramirez (1997) explain how the cross-national studies as a result of PISA assessments result in countries adopting similar national development goals, projects, and commitments and viewing education as a solution to gain global recognition. The differences in economic forces, power, and culture take on "standardized forms and soon appear to be similar to a hundred other nation states around the world" (Meyer, 1977, p. 152). The research shows how India too, a developing country, is focusing on teacher quality as an important school resource to improve the quality of education.

Influenced by international organizations, India has developed an official teacher evaluation tool named the Indian Performance Indicators (PINDICS), designed by NCERT at the policy level (Government of India MHRD, 2016a). The policymakers' expectations are that

[7] For example, to teach mathematics, a teacher has to be highly qualified in mathematics per the NCLB Act of 2001.

implementation of PINDICS will improve the teacher quality and increase the education quality per international standards, although there are no official results on this so far. In terms of teacher education, Indian policymakers are adopting education policies, similar to those in Western countries. For example, in the United States, there are more than 1,200 institutions that provide pre-service teacher education programs (Morey, Bezek, & Chiero, 1997). In India, the national policies are now focusing on teacher education programs, and their curricula have been revised four different times between 1978 and 2009 to reflect changes adopted in the global environment (Pandey, 2011).

Despite these similarities and shared conceptions surrounding teacher quality, loose coupling occurs in that policies made at the national level generally lose some of their intention by the time they are implemented at the local level. Loose coupling can occur due to poor implementation of policies or lack of resources or even lack of intent to implement international scripts at the local levels. This research determines the focus of Indian national policies on the teacher quality variables in the study but examination of loose coupling is beyond the scope of this research.

Summary of the theoretical framework. Human capital theory and world culture theory are heuristic tools that can be used to study globalization and complement, rather than contradict, each other through the different ways they work. While human capital theory highlights economic investment as the model that India is adopting to address teacher quality, as depicted in the national education policies, world culture theory allows for a different view on this. World culture theory uses the principle of globally shared norms, bounded rationality, and loose coupling to show how India is following a generally accepted model of educational improvement by focusing on teacher quality variables. World culture theory uses the focus on teacher quality

as an example of global convergence as more and more countries are focusing on teacher quality as a way to improve student outcomes. This study argues that the two theories have an important place in the study of teacher quality in India, one theory cannot be substituted for the other, and a single theory would not give a "bigger picture" of the topic. This is shown in Figure 3 below.

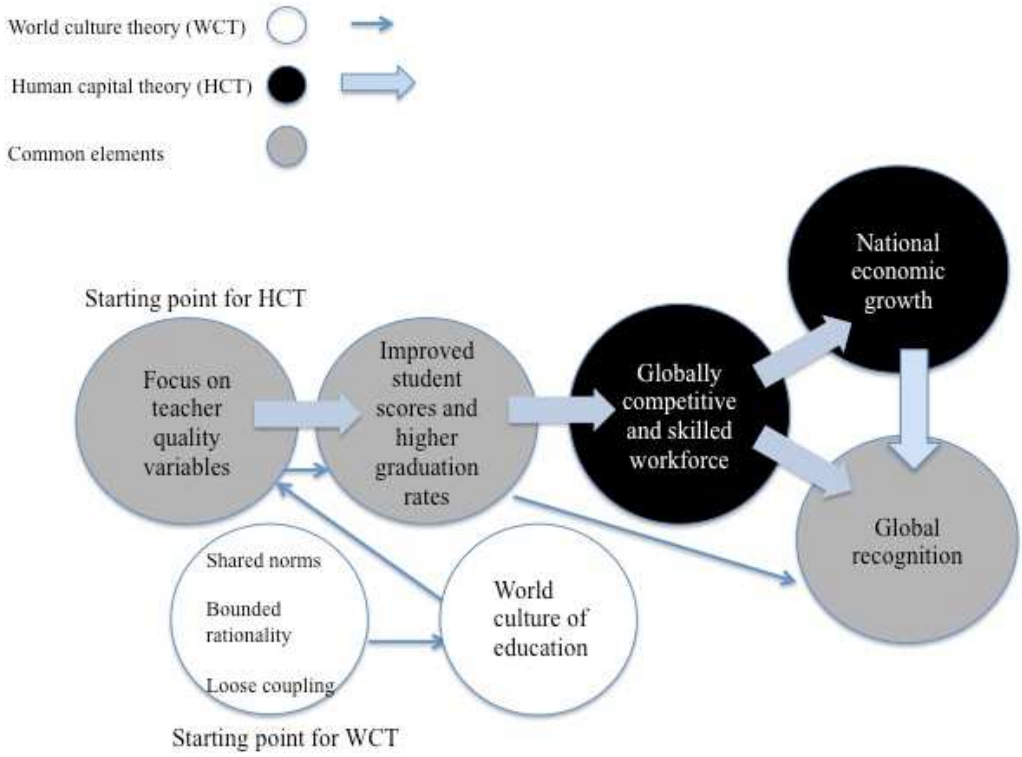

Figure 3. Elements of human capital theory and world culture theory applied to India's focus on teacher quality variables to improve the education quality.

In Figure 3, the circles represent the elements of human capital theory and world culture theory. The black circles represent the elements specific to human capital theory, the white circles show the elements specific to world culture theory, and the grey circles represent common elements of the two theories.

Investment in teachers' human capital results in improved student scores, a globally competitive and skilled workforce, and future economic returns for both the individual and the nation (Mincer, 1981). Therefore, policymakers should focus on the teacher quality variables that influence the student performance in mathematics the most. As explained previously in the discussion of human capital theory, human capital investment in appropriate teacher quality variables can result in increased skills, ability, and attitude and ultimately increased student achievement. Apart from gaining individual returns through competitive jobs based both locally and internationally, the skilled workforce can bring both economic enhancement for the country as well as global recognition.

Similarly, the white circles in the diagram represent the elements specific to world culture theory. According to the theory, globally shared norms, bounded rationality, and loose coupling give rise to a world culture which sees education and specifically teacher quality as a solution for development and global recognition (Lechner & Boli, 2005). India is embracing a world culture of education by participating in PISA 2009 and its focus on teacher quality as a measure to improve its student outcomes and education quality.

As Figure 3 shows, though the two theories are different, the proposed study argues that they complement each other as they have certain common elements denoted by the grey circles in the diagram. Though the process can differ as human capital deals with teacher human capital while world culture focuses on globally shared norms, bounded rationality, and loose coupling, both the theories focus on teacher quality to improve student outcomes and the education quality. This focus on teacher quality variables leads to a common goal of improved student outcomes. While human capital diverts towards economic returns on investment in teacher human capital, the world culture theory moves towards global recognition. Both the theories thus give a holistic

picture on teacher quality and its relation to student outcomes in India.

Chapter Three: Methodology

This mixed methods study uses qualitative and quantitative methods to examine the relationship of teacher quality variables, both traditional and non-traditional, on student achievement in mathematics. Through qualitative methodology, the study provides an understanding of how the national education policies are addressing teacher quality and answers RQ 1a and 1b. The content analysis of the documents shows which teacher quality variables are given priority by the government. Next, the quantitative research uses PISA 2009 mathematics data from schools in the Indian states of Himachal Pradesh and Tamil Nadu to analyze the relation of policy implications to teacher quality variables affecting student achievement in mathematics. The quantitative method answers RQ 2a, 2b, and 2c. Thus, the integration of qualitative and quantitative research in a single study provides a more holistic picture of the situation of teacher quality in India. The study aims to provide valuable information to policymakers for improving teacher quality in India.

The chapter on methodology is divided into two main sections: Qualitative Research Methodology and Rationale and Quantitative Research Methodology and Rationale.

Qualitative Research Methodology and Rationale

Research design. Content analysis as a qualitative research method is used to examine the selected official Indian national education policies to answer the first research questions:

RQ1a: How do Indian national education policy documents (NCF 2005, NCFTE 2009, and NEP 2016) frame traditional and non-traditional teacher quality characteristics in reference to student achievement gains?

RQ1b: How did Indian national education policy shift from 2005 to 2016 in reference to

traditional and non-traditional teacher quality characteristics and national competitiveness?

Content analysis as a method of analysis is non-participant or non-reactive for this study as there is no direct contact between the participants and me (Kuckartz, 2014); therefore, this study did not require any Institutional Review Board (IRB) approval.

The term *content analysis* is not new and dates back to the year 1910 when Max Weber suggested an enquiry into the content of a newspaper, thus introducing content analysis as a social science research method (Kuckartz, 2014). In respect to quantification of texts, Kuckartz (2014) states that while it can be insightful, the resulting matrix of numerical data is limited in what it can reveal about the text or phenomena under examination. The author argues that classical content analysis or quantitative approaches are not the best choice of method of analysis where subjective understanding and interpretation of text is required (Kuckartz, 2014). He introduced qualitative content analysis that focuses on "discovering the meaning within texts and analyzing their communicative content" (Kuckartz, 2014, p. 34).

Hsieh and Shannon (2005) define qualitative content analysis as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (p. 1278). Coding involves labeling segments of the text with brief words or phrases to distill the information to broad categories or themes (Neuman, 2014), which answer the research questions. The brief words or keywords selected are highlighted or color-coded in the text manually or through a software (Kuckartz, 2014).

Though content analysis reveals the content of the text, it cannot interpret it nor can it determine the "truthfulness of an assertion or evaluate the aesthetic qualities of literature"

(Neuman, 2014, p. 372), leading to an amount of bias. However, to answer the research questions stated in the study, content analysis is an appropriate choice because it helps reduce the volume of data in the three electronic versions of the official documents to a fairly manageable amount for ease in interpretation by me. Content analysis enables a thorough examination of the chosen Indian documents to understand how they address or do not address traditional and non-traditional teacher quality variables chosen for the study. The remainder of this section talks about document selection, constructs, reliability, validity, procedures, data analysis, and limitations of the study.

Document selection and policy briefs. The documents for analysis are the NCF 2005, NCFTE 2009, and NEP 2016. Critical examination of these documents addresses the situation of teacher quality related to student outcomes in mathematics. Although NCF 2005 and NCFTE 2009 are official curriculum frameworks, while NEP 2016 is an education policy, these three documents were chosen for analysis as they are an integral part of the Indian education system and contain discourse that is relevant to the study. Also, the three documents constitute the overarching policy documents that outline the education for schools in India including teacher education. These are official policy documents that are applicable to all the states in India including the states of Tamil Nadu and Himachal Pradesh. Since the research pertains to Indian participation in PISA 2009, I was unable to successfully search for any official state policy for Tamil Nadu and Himachal Pradesh with respect to education and teacher education. The chosen policies represent India, which includes the two states.

As India is a diverse nation with more than 22 different states and various levels of central and state governments, initially, the Indian Constitution gave permission to the state governments to make all decisions regarding education for their respective states. However,

control in the hands of the Central Government for education began with the advent of the NCF 2005 when a national curriculum for India was proposed in contrast to individual state curricula (NCERT, 2005). The argument was to propose a national system of education, with respect to curriculum, teacher education, and education requirements, that was capable of responding to India's geographical and cultural diversity, while integrating the country through common education goals and core values by taking input from various states. State governments were encouraged to convert the various policies into the language of the state by NCERT for the states (NCERT, 2005).

The documents chosen are national policy documents and accessible to the general public through an internet search.

NCF 2005. NCERT is responsible for reviewing and formulating the curriculum at regular intervals, considering the fact that a national curriculum cannot be a static document, but rather should be revised often to reflect dynamism and the diversity of society reflected in schools (NCERT, 2005). Therefore, the NCF 2005 is a result of revisions made to NCF 1975, 1988, and 2000 by NCERT in consultation with the National Steering Committee, 21 focus groups, and the position papers prepared by these groups (Yadav, 2013). NCF 2005 focuses on shifting the method of teaching from a textbook-centered, rote learning approach to one that emphasizes a link between learning in school and the outside world as a way to increase quality of education in India. Also, teachers are expected not just to follow a given syllabus or textbook but to also participate in creating the syllabus, textbooks, and learning aids. Therefore, teacher competency in respect to training and qualification is a major focus in NCF 2005.

NCFTE 2009. Recognizing the issues in the present teacher education scenario like the backlog of untrained teachers, increase in demand for trained teachers, lack of pre-service

teacher certification, increase in substandard teacher education institutions, and lack of teacher accountability, NCFTE 2009, developed by the NCTE, gives a systematic and comprehensive framework for teacher education. The NCFTE 2009, apart from curricular areas of initial teacher preparation, mainly addresses concerns about professionalization of teacher education, preparing teacher educators, open and distance learning, and research and innovation in teacher education.

The NCFTE 2009 has given a systematic framework for main curricular areas of teacher education along with strategies to implement it. It is comprehensive and includes Mathematics, Social Sciences, Language, Knowledge, Theory, Practice, and Psychological as well as Philosophical sections. The framework is divided into three areas: Area A, Area B, and Area C. While Area A and Area B include curricula like Foundations of Education and Curriculum and Pedagogy already included in the earlier teacher education program by NCF 2005, Area C includes school internship, which is a crucial part of a teacher's education. Area C includes visits to innovative centers of pedagogy and learning, classroom-based research projects, and weekly practical training in the classroom, making NCFTE curriculum for teacher education unique (Mondal, Saha, & Baidya, 2015).

NEP 2016. The main goal of NEP 2016 as stated in the draft is on improving the quality of education and restoring its credibility. It seeks to create conditions to improve the quality of teaching, learning, and assessment and to promote transparency in the management of education (Government of India MHRD, 2016a, p. 14).

Reinforcing the importance of quality education in India, NEP 2016 provides a framework for developing the education sector in the country. It recognizes that the education process, content, and policies need to evolve, keeping pace with the dynamics of local and global changes, including changes in learner needs (Government of India MHRD, 2016a). The

report emphasizes students' learning outcomes and connects them to quality of education imparted. To ensure implementation and follow-up on recommendations of the policies, the NEP 2016 proposes formulating a Framework for Action for each state and union territory in India.

Reliability and validity. To ensure intercoder reliability, another coder independently coded the text. A colleague from Lehigh University who is familiar with my research questions, keywords, and use of MAXQDA also scanned the full documents and conducted independent searches for the keywords. This step of pilot coding took about 10 days, when 10% of the relevant sections were chosen. An intercoder reliability of 80% was selected for this research (Kuckartz, 2014), and the coding scheme was revisited and refined until there was an agreement between me and my colleague on 80% of the coding in the pilot phase.

Validity in content analysis is proven when the results from the study are able to answer the research question (Creswell, 2012). Additionally, in content analysis, researchers must adhere to the core principle of validity, be truthful, and have a neutral and objective view during reporting (Neuman, 2014). Thus, making connections truthfully and objectively interpreting the results from the analysis increases the validity of the study.

Coding system. In content analysis, there are no standard measures to code and each study includes its own keywords. Coding requires systematic scanning of the documents, and Neuman (2014) identifies two types of coding: manifest coding and latent coding. Manifest coding includes counting the number of times the keyword appears in the text and is a reliable way of coding because it can be determined if the keyword is present or not in the text. However, the limitation of manifest coding is that it does not take into consideration the connotation of the keywords or phrases (Neuman, 2014). On the other hand, latent coding looks for "underlying

implicit meaning in the content of a text" (Neuman, 2014, p. 373). In this study, the latent method of coding was used.

The keywords, categories, and sub-categories were chosen from the literature review, PISA 2009 school questionnaire, and theoretical framework pertaining to teacher quality variables and then searched for in the text. Thus, the deductive method of coding, in which concepts or variables emerge from the theory or previous studies, was used in this study. In deductive methods of coding, codes exist first and are applied to the text with the intention of theory testing and not theory building (Kuckartz, 2014). The pre-determined codes or keywords are shown in Table 2 and Table 3.

Table 2

Traditional Teacher Quality Variable Keywords

Teacher Qualification Keywords	**Teacher Certification Keywords**	**Professional Development Keywords**
● Teacher qualification ● Teacher ● Qualification ● Diploma ● Entry qualification ● Master of Education (M.Ed.) ● Bachelor of Education (B.Ed.) ● Teacher human capital	● Teacher certification ● Teacher ● Certificate ● Valid ● Authority ● Acquired skills	● In-service training ● Online training ● Professional activities ● Western influence

Table 3

Non-Traditional Teacher Quality Variable Keywords

Teacher Salary/Performance Pay Keywords	**Teacher Absenteeism Keywords**	**Teacher Qualified in Mathematics Keywords**	**Teacher Attitude Keywords**

• Teacher salary/ Performance pay • Salary • Performance pay • Monetary incentive • Increments	• Absent • Out of class • Teacher attendance log • Teacher unpaid leave	• Subject-matter knowledge • Mathematics competency • Mathematics skill	• Teacher and student relationship • Positive teacher attitude • Teacher and student interactions • Motivated teachers

Procedures. There are at least five main phases in conducting a content analysis study: planning, development, pilot coding, coding, and analysis (Kuckartz, 2014) as shown in Figure 4. The first two phases are the planning and development phase that include determining the research question, hypothesis, and theoretical framework. The third phase is the pilot coding phase where the coding system and categories, sub-categories, and variables are developed. When choosing the categories and sub-categories, the categories must be ensured to have no overlap and be mutually exclusive (Kuckartz, 2014).

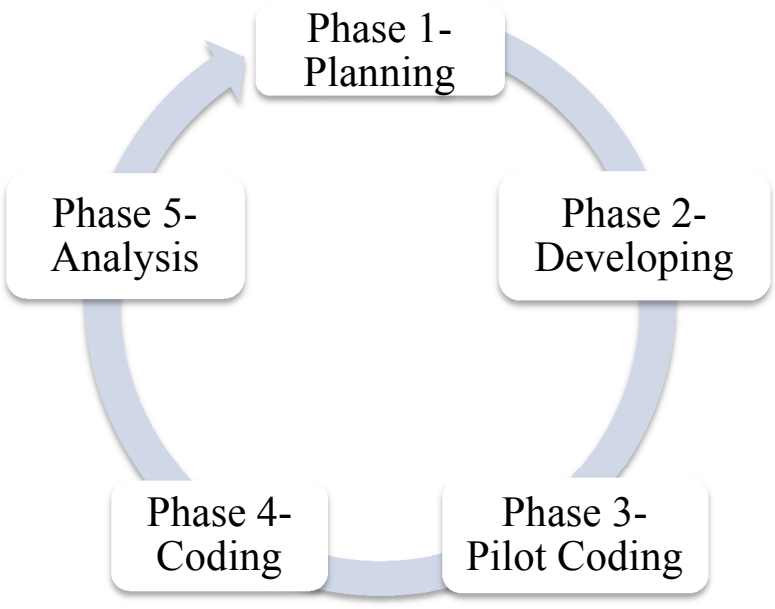

Figure 4. Phases in content analysis. Reprinted from Kuckartz (2014).

The Lehigh colleague had read the proposal prior to starting the pilot coding and had a good understanding of the research questions, theoretical framework, and literature review. Due to the limited number of documents and design of the coding scheme specifically for these documents, the same documents used at the final coding stage were used for pilot coding.

During the pilot coding stage, pages were selected from the NCF 2005, NCFTE 2009, and NPE 2016 (see Table 4). Tables of contents, introductions, epilogues, summaries, and any figures and diagrams were excluded from all three documents. The documents were manually scanned for the identified keywords and any synonyms to the keywords that were missed were added to the relevant categories or sub-categories in Tables 2 and 3. Since the number of documents was limited, data could be manually coded. Schreier (2012) recommends between 10% and 20% of the relevant pages as being a reasonable amount of material for pilot coding. Therefore, I chose 10% of the documents for pilot coding (see Table 4). The units of analysis were the individual sentences. Every group of words or bullet point that ended in a period was counted as a full sentence during pilot coding.

As shown in Table 4, to ensure variability, 43 pages (10%) of the total relevant pages (428) were coded during the pilot coding. On each page, sentences to code were manually numbered. While selecting the pages to be included for pilot coding, I have tried to include pages relevant to the predetermined categories.

Table 4

Pages Coded in Pilot Coding and Final Coding

Title	Year	Total Pages	Relevant Pages	Pilot Coded Pages	Final Coding Pages
NCF	2005	122	119	12	119
NCFTE	2009	92	92	9	92
NPE	2016	217	217	22	217
Total		521	428	43	428

Pilot coding consists of three stages (Schreier, 2012). In the first stage of trial coding, once the coders are familiar with the research questions, coding procedure, and codes, the trial coding begins. In this stage, both the coders worked independently during this period to code each sentence on the designated pages and thus tried out the viability of the coding frame. Comments or difficulties encountered were independently noted. The trial period for each of the documents lasted between two to four days each.

During the second phase of consistent check, the two coders met online several times for a period of nearly one week to clear differences and refine the definitions from the coding table. An Excel spreadsheet was individually maintained by each coder, and the coding was discussed after every few pages to get a better understanding of the scheme and codes. While coding each sentence in pilot coding, a separate category was created for sentences that did not fit any category, marked as "Irrelevant" in the Excel spreadsheets. This was to ensure that all of the data were assigned to categories.

The third stage of pilot coding led to adjustments in the coding frame and, therefore, the deductive coding procedure moved to inductive coding where new keywords and categories were added or deleted from the coding frame. For example, *transformative society* as a common keyword was added during pilot coding. Kuckartz (2014) notes that the first requirement in creating categories in the deductive approach is that "they are distinctive and exhaustive" (p. 27). Therefore, I have ensured that the categories did not overlap each other by clearly describing them as well as specifying the coding guidelines along with keywords in each category. The pilot coding, therefore, acted as a check for reliability to see how well the coding table was formulated in respect to the information needed for the research.

A final intercoder reliability coefficient of 89% was achieved, which is a good number to move to the final coding (Schreier, 2012). Details about this number can be found in Appendix A. Though deductive and inductive methods of coding were used and the existing codes were reviewed before final coding, even during final coding, I was open to any additions in the coding scheme that affected the research questions. The final coding scheme is given in Appendix B.

Once the simple percent agreement was reached, the study moved to the fourth and fifth phases. For the fourth phase of coding and the fifth phase of analysis, the study used MAXQDA, a software tool that supports qualitative research. This software allows for thematic and systematic analysis of written data (www.maxqda.com). This tool assisted in the coding process and was user friendly with clear instructions on how to use it. Although I had used it in a group and not independently, I felt confident using it. The three chosen documents were uploaded and the software assisted in searching for the presence of the keywords, which could have been overlooked if the search was done manually. Also, passages or excerpts containing the keywords were highlighted to derive the content regarding the keyword. For this study, the lexical search function of the software was used where keywords chosen were highlighted in every document. Keywords in each category were color coded differently. The keywords that are listed in Tables 2 and 3 relevant to each category and sub-category of chosen teacher quality variables were searched for and analyzed for their content and not for the number of times they occurred in each document**.**

I conducted the final coding of the documents in the order of publication dates as shown in Figure 4: NCF 2005 followed by NCFTE 2009 and finally NPE 2016. Using the MAXQDA software, each document was uploaded one at a time and coded sentence by sentence. Each category, including an "Irrelevant" category for sentences not applicable to the current study,

was color coded differently. MAXQDA automatically numbers the sentences during coding which assisted in creating the coding matrix for frequency count. Once each document was coded with MAXQDA, I conducted a lexical search for the keywords (manually checking for every single word under the heading "subcategory/keywords") to ensure that relevant sentences were not missed while coding. Each sentence was manually coded using the lexical search and crosschecked with the results from the MAXQDA coding and the pages coded during the pilot coding. This was to ensure further reliability in the coding.

MAXQDA also features the ability to summarize, store, and retrieve notes made during the search to assist in data analysis. It has a unique feature of providing space on every page for summary and write-ups (www.maxqda.com). Additionally, MAXQDA has numerous visual tools that assist in data analysis and summary writing. I used the space provided to make notes during coding and also used the "summary grid." The grid was a great visual tool to note and compare keywords in all the three chosen documents, which assisted in answering the research questions (www.maxqda.com).

Data analysis means a search for patterns in data, and once the patterns are determined the researcher interprets them to answer the research question (Neuman, 2014). However, this study did not merely count keywords or derive objective meaning from common themes or patterns. I tried to understand the situation of teacher quality variables in a subjective manner. I analyzed the documents chronologically (NCF 2005, NCFTE 2009, and NPE 2016). The first step in the analysis was going to each of the coded sentences in their respective documents and comparing the results in MAXQDA. I read through each of the sentences, storing relevant notes in MAXQDA, and also making any coding adjustments. Once the data were ready and their frequencies recorded, I looked for information required for my research questions and common

phrases or themes in all the three documents. Detailed qualitative results are presented in the following chapter.

While the initial categories and keywords were derived deductively from the research questions, literature review, theoretical framework, and PISA questionnaires, the study was open to looking for new categories or themes and keywords inductively derived during analysis. Thus, during my data analysis I found a common category or theme *teacher accountability* in all the three documents that was relevant to the study**,** shown in Table 5.

Table 5

Additional Teacher Quality Variable from NCF 2005, NCFTE 2009, and NPE 2016

Category	Description	Coding Guidelines	Subcategory/Keywords
Teacher Accountability	Teacher responsibility towards student learning	Cannot include teacher attitude towards students.	Autonomy, responsibility, student/teacher independence, teacher assessment

Finally, the research questions and theoretical framework aided in interpreting the results. For the study, I adopted an interpretive approach to understand how each individual chosen document dealt with the traditional and non-traditional teacher quality variables. Even after categories were assigned to the text, I paid attention to the wording of each sentence in the context of the relevant paragraph to understand the meaning in its entirety.

Limitations of the method. Bowen (2009) asserts that documentation in content analysis is more a potential flaw than a limitation. The documentation flaw occurs due to the fact that most of the documents are not created for research and, therefore, the information can be insufficient to answer the research question. The research has reduced this flaw by choosing

three overarching policy documents that outline the education for schools in India including teacher education.

Similarly, Kuckartz (2014) outlines three potential threats to content analysis: anecdotalism, trustworthiness, and transparency. Kuckartz (2014) explains that anecdotalism happens when selected parts of a text or document are used for the analysis, which can give an inaccurate picture of the data. In this study, I avoided anecdotalism by selecting and uploading and coding the full three documents. Next, to reduce the possible threat of trustworthiness, I followed the procedure outlined in the study and analyzed the data objectively. Finally, by outlining detailed explanations on the units of analysis, constructs, coding and analysis methods, I have tried to maintain transparency in the study.

Quantitative Research Methodology and Rationale

By identifying the teacher quality variables that have the strongest relationship with student performance in mathematics in PISA 2009, the study collected relevant information. The information may assist policymakers in adjusting the education resources to relevant teacher quality variables that increase student performance in mathematics. This section looks at the quantitative methodology of the study.

The quantitative method of the study used correlation analysis and multiple regression to determine how traditional or non-traditional teacher quality variables influence student performance in mathematics on PISA 2009 testing. It also determined individually which of the traditional and non-traditional teacher quality variables most strongly influence student performance in mathematics. A correlation analysis shows the direction and strength of the relationship between two or more variables (O'Brien & Scott, 2012) and, for this research, multiple regression showed the magnitude of the relationship between the teacher variables, both

traditional and non-traditional, to student performance in mathematics.

Since correlation analysis is limited to only establishing a relationship between two variables (O'Brien & Scott, 2012), the study also used multiple regression. Multiple regression helps determine the predictive power of the independent variables on the dependent variable (O'Brien & Scott, 2012). Therefore, in the study, multiple regression assisted in examining the relationships between the various independent teacher variables and the dependent variable—student performance in mathematics—and identified the "best predictor of an outcome amongst a set of variables" (O'Brien & Scott, 2012, p. 5).

For the correlation analysis and multiple regression, Statistical Software for Social Sciences (SPSS), now called the IBM SPSS version 24, was used for calculations and graphing. The International Database (IDB) analyzer by the International Association for the Evaluation of Educational Achievement is an add-on to SPSS and uses appropriate weighted estimates for analyses of large assessments like the PISA for unbiased results (IEA, 2013). The mathematics literacy scores of students are represented in plausible values and not actual student scores. The analyzer has an analysis module that has the capability of including plausible values as dependent or independent variables.

Research design. Correlation analysis and multiple regression were used to answer the quantitative research questions:

RQ2a: Which traditional teacher quality variables are most strongly related to student mathematics performance in India?

RQ2b: Which non-traditional teacher quality variables are most strongly related to student mathematics performance in India?

RQ2c: How are traditional and non-traditional measures of teacher quality differently related to student mathematics performance in India?

The OECD has collected data on teacher quality variables which were considered for the study and student performance in mathematics. The data collected from the OECD PISA 2009 database is continuous for some variables and nominal for some variables for Tamil Nadu and Himachal Pradesh. The data from the school questionnaire and student questionnaire in PISA 2009 for the two states was filtered and merged to produce data considered representative of India in this research, since the study is not a comparative study between the two states.

Each traditional and non-traditional teacher quality variable was compared to the students' mathematics performance or the mathematics scores for PISA 2009. SPSS and the IDB analyzer were used to generate Pearson's coefficient *r* (+1 to -1) to establish the relationship between the teacher quality variables, both traditional and non-traditional, and the mathematics performance.

Next, the IDB analyzer and SPSS were used for correlation analysis and multiple regression. O'Brien and Scott (2012) state that multiple regression is a method used to answer research questions that relate to "how well a set of variables can predict a particular outcome" and "identification of the best predictor of an outcome amongst a set of variables" (p. 5). Thus, the research method allowed determination of whether it is the traditional teacher quality measures or the non-traditional teacher quality measures that are most strongly related to the outcome and the individual contribution of each variable to the outcome variable (O'Brien & Scott, 2012). Two simple multiple linear regressions were used in which traditional and non-traditional teacher quality variables were entered into their respective equations in the IDB analyzer and SPSS separately. There was no hierarchy of any variable maintained in the study.

Hypotheses. The quantitative analysis in this study tested three initial hypotheses regarding teacher quality variables and student performance in mathematics. Teacher quality is divided into two broad categories in this study: traditional teacher quality variables and non-traditional teacher quality variables. The traditional teacher quality variables include teacher qualification, teacher certification, and professional development. In comparison, the non-traditional teacher quality variables include teacher subject-matter qualification, teacher absenteeism, teacher attitude, and teacher salary. The three initial hypotheses presented are based on both the theoretical framework and the literature review.

The first hypothesis suggests that, of the traditional teacher quality variables, student performance in mathematics is significantly dependent on professional development of teachers. The ongoing and subject-related professional development will improve teachers' content knowledge as well as their teaching practices. Professional development will provide teachers with updated key strategies to teach the subject, which will significantly influence student achievement in mathematics (Wenglinsky, 2002). Therefore, the first hypothesis states:

> H2a: Of the traditional teacher quality variables, student performance in mathematics is significantly related to professional development of teachers.

Interestingly, in India, the importance of professional development for the teachers stems from the Vedic period[8] where activities like *yatras*[9] and *kathas*[10] were organized for teachers, though not systematically as compared to programs in the current times (Tiwari, 2016). Although currently India has some professional development models like the Split model, the Site-based model, and the Self-directed models, they have failed to bring about any effective changes in

[8] Vedic Period: (c. 1500 - c. 600 BCE)
[9] *Yatras* are where teachers travel around the country to learn from other teachers in different schools.
[10] *Kathas* are stories that add to the existing knowledge of the teachers.

education (Tiwari, 2016). As India is embracing the world culture of education, it is learning from international models of continuous professional development, like the Michigan Teacher Excellence Program (MiTEP), Inquiry Learning, and Collaborative Learning (Tiwari, 2016), the importance of providing relevant professional development activities for teachers to improve teacher quality. Also, Tiwari (2016) states that evidence suggests students benefit "from teachers who are not only qualified and experienced but at the same time always have an updated knowledge base" (p. 1).

Moving to the second hypothesis, evidence suggests that the regular presence or attendance of a teacher is vital in the education of a student; thus, teacher absenteeism is a measure of teacher quality (Uehara, 1999). Also, teacher absenteeism gives an incorrect message to the students that school attendance is not important, and it has a negative impact on student outcomes (Uehara, 1999). In India, teacher absenteeism is a major issue leading to a loss of over $2 million in education spending (Patrinos, 2013). Interestingly, a study by Muralidharan, Das, Holla, and Mohpal (2013) showed that teacher absenteeism, though high in India, varies across its states. High performing states like Tamil Nadu, Maharashtra, and Punjab have teacher absenteeism rates below 15% compared to other states. Therefore, the second hypothesis states:

> H2b: Of all the non-traditional teacher quality variables, student performance in mathematics is significantly related to teacher absenteeism.

Hypothesis 2b suggests that out of the non-traditional teacher quality variables, teacher absenteeism is most strongly related to student performance in mathematics. The rationale behind this is that the classroom is the primary venue in which students and teachers interact; therefore, when a teacher remains absent, students miss out on crucial learning in mathematics and daily practice, which is essential for a practical subject like mathematics (Porres, 2016).

Finally, the third hypothesis suggests that in India, performance of students in mathematics is significantly related to non-traditional teacher quality variables. For example, India is a developing country and the human capital theory states that investment in teacher quality acts as a future investment for the country and also for individuals (Mincer, 1981). Teacher salary in India is low compared to the international level (Varmal, 2014), and, therefore, monetary incentives like teacher performance pay and salary increases act as a strong motivator. Furthermore, the literature review also shows performance pay and increased pay structures for teachers have been indicated to impact student performance in mathematics (Kingdon & Teal, 2007). Therefore, the third hypotheses states:

H2c: In India, performance of students in mathematics is significantly related to non-traditional teacher quality variables more than traditional teacher quality variables.

Based on the world culture theory, India is embracing certain educational norms or standards to be a part of the global world culture in education. For example, similarly to the education systems in the West, and in particular the United States, where teacher subject-matter competency is required to teach a particular subject, in India too, subject-matter competency in mathematics is a key priority in the NCF 2005 (NCERT, 2005). Also, evidence suggests a positive relationship between teacher subject-matter competency in mathematics and student achievement in mathematics (Rowan, Chiang, & Miller, 1997; Wenglinsky, 2002).

Participants. The OECD collected data for the fourth cycle of PISA assessments in 2009. There were originally 65 participating countries or economies. Thirty-four were member countries, and 10 additional economies or countries could not participate within the PISA 2009 timeframe, participating instead in the PISA 2009 plus project (Walker, 2011). India participated in the 2009 plus testing. The data and results of PISA 2009 plus were merged with the 2009 data

and results.

PISA testing is administered to 15-year-olds from seventh grade and above, and PISA seeks to be as inclusive as possible in respect to both students and schools who are participating. There were 1,616 students from seventh grade onwards that participated in PISA 2009 in Himachal Pradesh and 3,210 students from Tamil Nadu. The total number of students, 4,826, is considered a good sampling base for this study. Students from diverse socio-economic backgrounds and abilities participate in PISA, and schools can exclude students from participating in the tests if they are intellectually disabled, have functional disabilities, or if they have low English language experience (OECD, 2010). Furthermore, private and public schools participate in the tests, although special needs or small schools in remote regions are excluded.

Indian states of Himachal Pradesh (QHP) and Tamil Nadu (QTN) were the only two states of India that participated in the 2009 plus testing and were the participants used for this study. The country code for India is a three-character code (356) representing Himachal Pradesh (HP) and Tamil Nadu (TN). A total of 213 schools from both the states participated in the PISA 2009 assessment, of which 66 schools were from Himachal Pradesh and 147 schools were from Tamil Nadu. In total, there were 138 public schools and 65 private schools that participated, while information about 10 schools was missing. Since there was no human subject research, IRB approval was not required for the study.

Data integrity. The PISA is a reliable and valid test for mathematics, science, and reading (OECD, 2012) as a result of numerous features. For comparability of results, students' responses are coded in a uniform way country to country. For this, the OECD provides international training for two representatives from each country. The reliability score for mathematics is 0.882 and 0.75 for the survey questionnaire. Additionally, for construct validity,

PISA uses the Cronbach's alpha approach to ensure consistency between countries. Strict control and standards are set by the Technical Advisory group of the OECD to reduce bias in data collection and documentation (OECD, 2012). It is stated that "internationally developed instruments are widely examined for cross-national, cross-cultural and cross-linguistic validity and that the interests and involvement of national stakeholders are considered throughout the study" (OECD, 2012, p. 368).

Storage. No storage or filing of any data was required as the data was secondary data collected by the OECD. The data used for this study was easily accessible to all through the OECD website.

Sampling. The sampling design used in the PISA 2009 assessment was the two-stage stratified sample design. The international target population for PISA 2009 included all 15-year-old students from seventh grade and upwards studying in educational institutions (OECD, 2012). In respect to the 15-year-old age criteria, OECD specified that for countries participating in April 2009, students born in 1993 attending educational institutions were eligible for the testing.

For school selection, the OECD maintained that the school sampling frame was comprehensive and included "any school that could have 15-year-old students, even those schools which might later be excluded, or deemed ineligible because they had no PISA-eligible students at the time of data collection" (2012, p. 66). Within each selected school, a student listing form, including a number of criteria, was prepared to determine student eligibility for PISA testing. Age-eligible students were students born in 1993 (or the appropriate 12-month age span agreed to by the participating country). It was suggested that schools retain a copy of the student list in case the National Project Manager had to contact the school with questions. Student lists were to be up-to-date at the time of sampling rather than a list prepared at the

beginning of the school year. Students were identified by their unique student identification numbers (OECD, 2012, p. 40).

Once the National Project Managers received the student listing form from the schools, student sampling was done using Key Quest, a PISA Consortium Software (OECD, 2012). All participating countries, excluding Germany, used the Key Quest. To select students from the list, PISA 2009 used two-stage stratified sampling wherein the first stage schools were selected from a comprehensive list of PISA eligible schools, and in the second stage, students were selected from the schools chosen in the first round. In general, 35 students from each school were randomly chosen from the list. If the number of students was low, then all students from the school were selected (OECD, 2012). OECD ensured "students were a representation of the full target population of 15-year-old students in the participating country" (2012, p. 58).

Variables. The OECD used the survey method to collect data on each teacher variable selected for the study (OECD, 2010). The student mathematics responses were taken from the student data file available on the PISA 2009 website. The descriptions of the variables chosen for traditional and non-traditional teacher quality are listed below.

Independent Variables (IV)—Traditional teacher quality variables.

Teacher qualification —full time. This variable is assessed by asking the following question: "How many of the following teachers are on the staff of your school?—Full time ISCED5A qualification" (SC09Q31[11]).

Teacher qualification—part time. For part time, fully qualified teachers, the question "How many of the following teachers are on the staff of your school?—Part time teachers ISCED5A qualification" (SC09Q32) applies.

[11] The questions are from the school questionnaire from the compendium file in the PISA 2009 database. The questions are denoted by their respective question numbers for reference.

Teacher certification—full time. This variable is assessed by asking the following question: "How many of the following teachers are on the staff of your school?—Full time teachers fully certified" (SC09Q21).

Teacher certification—part time. For part time, fully certified teachers, the question "How many of the following teachers are on the staff of your school?—Part time teachers fully certified" (SC09Q31).

Professional development. This variable is assessed by the following statement, "The school management makes sure that the professional development activities of teachers are in accordance with the teaching goals of the school" (SC26Q01). The responses are categorical: *Never* with a score of 1, *Seldom* with a score of 2, *Quite often* with a score of 3, and *Very often* with a score of 4.

Independent Variables (IV)—Non-traditional teacher quality variables.

Teacher absenteeism. This variable is assessed by the question text, "To what extent is the learning of students hindered by the following phenomenon—teacher absenteeism?" (SC17Q06). The variable is categorical and scored by ticks. According to the codebook, *Not at all* scores 1, *Very little* scores 2, *To some extent* scores 3, and *A lot* scores 4.

Teacher qualified in mathematics subject. This variable is assessed by the question, "Is your school's capacity to provide instruction hindered by any of the following issues—lack of qualified mathematics teachers?" (SC11Q02). The variables are categorical and scored by ticks. According to the codebook, *Not at all* scores 1, *Very little* scores 2, *To some extent* scores 3, and *A lot* scores 4.

Teacher attitude—Poor student-teacher relationship. This variable is assessed by the question, "Is your school's capacity to provide instruction hindered by any of the following

issues—poor teacher and student relationship?" (SC17Q03). The variable is categorical and scored by ticks. According to the codebook, *Not at all* scores 1, *Very little* scores 2, *To some extent* scores 3, and *A lot* scores 4.

Teacher attitude—Teachers being too strict with students. This variable is assessed by the question, "Is your school's capacity to provide instruction hindered by the following issues—teachers being too strict with students?" (SC17Q06). The variable is categorical and scored by ticks. According to the codebook, *Not at all* scores 1, *Very little* scores 2, *To some extent* scores 3, and *A lot* scores 4.

Dependent Variable (DV).

Student mathematics scores. The data for the student mathematics scores is obtained from the student data file. The mathematics literacy scores are available for all the 4,826 students that participated in PISA 2009 testing from India. The mathematics scores are reported as plausible values pvmath1, pvmath2, pvmath3, pvmath4, and pvmath5. Plausible values are a kind of student ability estimate (OECD, 2010).

Instrument.

Mathematical literacy and assessment. PISA assesses outcomes in three areas: reading literacy, mathematical literacy, and science literacy. Mathematical literacy in PISA is defined as:

> An individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgments and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen. (Walker, 2011, p. 4)

The PISA mathematical assessment is concerned with real life problems that go beyond what is encountered in school classrooms. The assessment is concerned with testing students'

ability to analyze, reason, and communicate effectively through solving the 35 questions. According to OECD (2010), the questions are broadly grouped in three clusters:

1) *The situation or context*, which is the setting of the problem or all the elements used to formulate the problem. OECD (2010) explains that most of the problems in this cluster are real-world problems where students need to apply mathematics. For example, in this cluster, problems can be based on finance or banking.

2) *The mathematical content*, in which all the problems cover the four overarching mathematical ideas of space and shape, change of relationships, quantity, and relationships.

3) *The mathematical competencies*, which are the fundamental processes that students use to solve the real-world problems. They are further divided into three clusters: the reproduction cluster (requiring reproduction of practiced knowledge), the connection cluster (making connections involving familiar or non-familiar settings), and the reflection cluster (requiring formulation and implementation of solutions).

The PISA 2009 mathematical literacy assessment was completed individually by all the students in a paper and pencil-testing format for two hours. An additional 40 minutes was given to complete the mathematics and science sections when a computer was used. The mathematics assessment consists of 35 multiple-choice questions and questions for which students have to calculate their own answers (OECD, 2010). The student performance in mathematics was stored in a data file called the student data file (OECD, 2010). The student data file has information on student identification number, school identification number, student age and gender, family background, and mathematics, science, and reading literacy scores.

The school questionnaire tool used for this study was filled out by school principals

mostly through the paper and pencil format. The school questionnaire has questions about school resources, a school's instructions, curriculum and assessment, school climate, school policies, structure and organization of the school, and the characteristics of the principal (OECD, 2010). The school questionnaire and mathematics assessment are administered every three years (OECD, 2010).

Data collection. The PISA 2009 data for the study is a secondary data type, which is collected by the OECD. Data is accessed using the database from OECD 2009 that is accessible to the public (www.oecd.org/2009pisa). The data collection procedures are strictly monitored for documentation of data collection and implementation of procedures (OECD, 2012). The procedures for data collection are consistent in every participating country to ensure high data quality (OECD, 2012). Data for the Indian states of Himachal Pradesh and Tamil Nadu were accessed from the school data file and student data file. The school questionnaire created by the OECD has 27 questions to gather information on school resources among other areas. The school questionnaire is answered by the principal or designate. The pvmath scores were obtained from the student data file.

Procedure. Since the research is a non-experimental study, the data was secondary and was collected from the PISA 2009 student data file and school data file. The data for the student mathematics performance (dependent variable) was collected from the student data pertaining to India. To reduce the length of the test, PISA applied matrix sampling, which splits one long test booklet into several short test booklets. Therefore, each student works on one booklet only. Because students complete different tests, mathematics achievement cannot be obtained using traditional test scores, but instead by using plausible values. Responses in the student data for mathematics is grouped under five plausible values (pvmath1 to pvmath 5). Instead of obtaining

a point-estimate for student ability, which is a traditional test score for each student, plausible values are derived for each student (Neuschmidt, 2017).

The independent variables (traditional and non-traditional) were derived from the school data file, which has data for the selected teacher variables. The type and measurement of each variable is given under the heading "Independent Variables (IV)—Traditional teacher quality variables" and "Independent Variables (IV)—Non-traditional teacher quality variables." The school data-file relating to traditional and non-traditional teacher quality variables was merged with the student data file, and the key field was the school ID.

Each traditional and non-traditional teacher variable was compared to the mean student score for every participating student in every participating school in the Indian states of Himachal Pradesh and Tamil Nadu.

Data analysis. There were two main data analysis methods or techniques used in this study: correlation analysis (Chen & Popovich, 2002; O'Brien & Scott, 2012) and multiple regression (O'Brien & Scott, 2012). The IDB analyzer and SPSS were used to analyze the data.

Correlation analysis. The first step is to check for basic assumptions for correlation analysis. This is to ensure that the data to be analyzed can be analyzed using the selected correlation tests. The IDB analyzer uses Pearson's correlation test. The first assumption is that the variables are continuous, and the data is a random sample from the population (O'Brien & Scott, 2012). Since a few variables were continuous and some were categorical, Pearson's correlation test was conducted on the continuous independent teacher quality variables and the numeric dependent mathematics score variable. The second assumption, which is important for Pearson's *r*, is to check that the variables are normally distributed (Chen & Popovich, 2002). As the sample size was large (in the thousands), this assumption was not required to be tested.

Furthermore, descriptive statistics and correlation analysis were run on all the chosen independent or predictor variables to determine their relevance in the study. The test of multicollinearity is essential and is checked through multiple regression analysis.

Multiple regression. There are a few assumptions in multiple regression which were examined before running multiple regression for valid results. First, it is assumed that the dependent variable is continuous. The pvmath variable (dependent variable) was numeric and, therefore, fulfilled the first assumption. Second, there should be two or more independent variables that are either continuous or categorical (ordinal or nominal). The traditional variables were all continuous except professional development, which was categorical. In respect to non-traditional teacher quality variables, they were mainly categorical. The third assumption is the independence of observation or independence of residuals. Generally, a Durbin-Watson test available on SPSS is used to test this assumption. However, in this study, this test was not used as this data was not time series data or chronological data.

The fourth assumption checks for a linear relationship between the independent and dependent variables. Linearity is checked only for numeric data. This study used scatterplot visuals to check for linearity using SPSS. The fifth assumption, that there is no multicollinearity between independent variables, is tested through multiple regression. The sixth assumption is that there are no outliers that can distort the results. Cleaning the data files with the IDB analyzer and SPSS was one way to remove outliers by deleting unwanted data. Some of the predictor variables were categorical and hence were dummy coded for their inclusion in the regression model by the IDB analyzer and SPSS.

Hypothesis 2a suggests that out of the traditional teacher quality variables, professional development is most strongly related to student performance in mathematics. Correlation

analysis and multiple regression were used. When correlation analysis and multiple regression were run on all traditional teacher quality variables together with student performance in mathematics, the association of professional development on student performance was revealed to test the hypothesis.

Hypothesis 2b suggests that of the non-traditional teacher quality variables, teacher absenteeism is most strongly related to student performance in mathematics. To test this hypothesis, correlation analysis and multiple regression were conducted. There were multiple non-traditional teacher quality variables that are related to student performance in mathematics; therefore, correlation analysis and multiple regression were the appropriate tools used to test the hypothesis.

Hypothesis 2c suggests that non-traditional teacher quality variables are strongly related to student performance in mathematics. To test this hypothesis, correlation analysis and multiple regression were conducted. There were multiple non-traditional teacher quality variables that are related to student performance in mathematics; therefore, correlation analysis and multiple regression were the appropriate tools used to test the hypothesis.

Chapter Four: Results

This chapter presents findings and results from the qualitative and quantitative data gathering and analysis to answer the research questions. It is divided into two sections, the qualitative phase and the quantitative phase. The qualitative phase begins with a brief review of the methodology. It is followed by qualitative coding data in matrix tables and representation of the data in the chosen documents, NCF 2005, NCFTE 2009, and NPE 2016. The quantitative phase also begins with a brief review of the methodology. It is followed by three sections: preliminary data analysis, primary data analysis, and results. Chapter Four concludes with a summary of the findings of both the qualitative and quantitative phases.

Qualitative Phase

The methodological approach chosen for the qualitative part of the study was content analysis. Content analysis is an appropriate tool to reduce the volume of the three selected policy documents to a fairly manageable amount for ease in interpretation by the researcher. Content analysis enables a thorough examination of the chosen Indian documents to understand how they address or do not address traditional and non-traditional teacher quality variables and thus aid in answering the research questions.

The following section presents the results of coding the three chosen documents for both the traditional and non-traditional teacher quality variables.

Qualitative results. Data frequency matrices (see Tables 6 and 7) that show the percentage of sentences coded in each category in relation to the total number of sentences, including those marked as "Irrelevant" to the study were used to compile the results to answer the research questions.

Table 6

Data Frequency Matrix for Traditional Teacher Quality Variables

	Teacher Qualification		Teacher Certification		Professional Development		Irrelevant Sentences in Document		Total Sentences in Document	
Document	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**
NCF 2005	197	13	0	0	101	7	1189	87	1521	100
NCFTE 2009	345	40	3	1	201	23	256	30	848	100
NPE 2016	40	3	1	0	15	1	1433	92	1555	100

Note. S denotes the number of sentences for each category in individual documents. Percentages are rounded to the nearest 1%. The numbers of irrelevant sentences and total sentences in each document are the same for Tables 6 and 7.

Table 7

Data Frequency Matrix for Non-Traditional Teacher Quality Variables Including Teacher Accountability

	Teacher Salary/ Performance Pay		Teacher Absentee -ism		Teacher Qualified in Mathematics		Teacher Attitude		Teacher Account- ability		Irrelevant Sentences in Document		Total Sentences in Document	
Document	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**
NCF2005	0	0	0	0	0	0	23	2	11	1	1189	87	1521	100
NCFTE 2009	11	2	10	1	2	1	7	1	13	2	256	30	848	100
NPE 2016	5	1	38	3	3	1	6	2	5	3	1452	92	1555	100

Note. S denotes the number of sentences for each category in individual documents. Percentages are rounded to the nearest 1%. The numbers of irrelevant sentences and total sentences in each document are the same for Tables 6 and 7.

Table 6 shows the number and percentage of coded sentences pertaining to each traditional teacher quality variable. In NCF 2005, there were 1,521 sentences. Of these, 1,189 (87%) of the material was irrelevant to the categories based on the coding guidelines. From the relevant material in NCF 2005, there were 197 sentences (13%) coded for teacher qualification, 0 sentences (0%) coded for teacher certification, and 101 sentences (7%) coded for professional development. For NCFTE 2009, there were 848 sentences, out of which 256 sentences (30%) were irrelevant. From the sentences relevant to the study, 345 sentences (40%) were coded for

teacher qualification, three sentences (1%) were coded for teacher certification, and 201 sentences (23%) were coded for professional development. For NPE 2016, there were 1,555 sentences, out of which 1,433 sentences (92%) were irrelevant to the study. From the relevant sentences, 40 sentences (3%) were coded for teacher qualification, one sentence (0%) was coded for teacher certification, and 15 (1%) were coded for professional development.

Table 7 shows the number and percentage of coded sentences pertaining to each non-traditional teacher quality variable. For NCF 2005, there were 1,521 total sentences in the document, out of which 1,189 (87%) were irrelevant to the categories based on the coding guidelines. From the relevant material in NCF 2005, there were 0 sentences (0%) coded for teacher salary/performance pay, 0 sentences (0%) coded for teacher absenteeism, 0 sentences (0%) coded for teacher qualified in mathematics, 23 sentences (2%) coded for teacher attitude, and 11 sentences (1%) coded for teacher accountability. For NCFTE 2009, there were 848 total sentences in the document, out of which 256 (30%) were relevant to the study. From the relevant sentences in NCFTE 2009, 11 sentences (2%) coded for teacher salary/performance pay, 10 sentences (1%) coded for teacher absenteeism, two sentences (1%) coded for teacher qualified in mathematics, seven sentences (1%) coded for teacher attitude, and 13 sentences (2%) coded for teacher accountability. Finally, for NPE 2016, there were 1,555 total sentences in the document, out of which 1,433 (92%) were irrelevant to the studies. From the relevant material in NPE 2016, five sentences (1%) coded for teacher salary/performance pay, 38 sentences (3%) coded for teacher absenteeism, three sentences (1%) coded for teacher qualified in mathematics, six sentences (2%) coded for teacher attitude, and five sentences (3%) coded for teacher accountability.

The following sections discuss what each of the policy documents state with respect to each traditional and non-traditional teacher quality variable. The results are useful in answering the first research question, which asks how the policy documents frame both the traditional and non-traditional teacher quality variables.

Teacher quality discourse in 2005—NCF 2005. Throughout the NCF 2005, there is ample evidence of teacher quality discourse that links quality education and teacher quality. Further, NCF 2005 also highlights teachers as key stakeholders to student learning and outcomes. For example, in respect to teacher quality, NCF 2005 states:

> The availability of qualified and motivated teachers who perceive teaching as a career option applies to all sectors of schools as a necessary precondition for quality. … No system of education can rise above the quality of its teachers, and the quality of teachers greatly depends on the means deployed for selection, procedures used for training, and the strategies adopted for ensuring accountability. (p. 8)

NCF 2005 argues that improvement in teacher quality, apart from improving student learning outcomes, will eventually restructure the globe into a place devoid of conflicts. Addressing the globe as "our transformative world," NCF 2005 addresses ways to "modernize" the system of education to be on par with the world economy (p. 3), where teachers play the role of facilitators and not just individuals who burden children with rote memorization and excessive knowledge. Additionally, NCF 2005 states that "in the context of a fast-changing world and a competitive global context, it is imperative that we respect children's native wisdom and imagination" (p. 6) and adequately prepare teachers. In this respect, it looks at some key important teacher qualities to enhance student education quality in the country.

Traditional teacher quality variables.

Teacher qualification. NCF 2005 uses the terms "teacher preparation" and "teacher education" in lieu of teacher qualification. It advocates that in order to strengthen teacher education, a new teacher education program should be formulated at pre-primary, primary, secondary, higher secondary, and graduate levels, and it should be under a recognized university. Also, the teacher education program should be a five-year program after the 10 + 2 level of school education followed by the country (NCERT, 2005). NCF 2005 urges including components of special education, training for effective diagnostic testing for remedial efforts, and awareness of a well-planned student assessment as part of the teacher education program. NCF 2005 further stresses adequate teacher preparation and support for teachers to improve student outcomes, showing that one way to define quality of education in India is through a child's performance. Furthermore, the role of institutions of higher education in teacher education is highlighted in NCF 2005 where it states, "Institutions of higher education have an important role to play in teacher education and in enhancing the professional status of teachers" (p. 122).

In regards to strengthening teacher education, NCF 2005 vocalizes the need for involvement of experts and teachers in preparing teacher education curriculum. Addressing the existing teacher education curriculum in the education programs, the document remarks, "Existing teacher curriculum neither accommodates the emerging ideas in context and pedagogy nor addresses the issue of linkages between the school and innovative educational experiments" (p. 107). The teacher education curriculum should contain core competencies that teachers at all levels from pre-primary to graduate levels will follow before their choice of specialization. NCF 2005 adds that "[e]mphasis on these programs should be on enabling teacher trainees to acquire

the ability for self-learning and independent thinking" (p. 107). NCF 2005 argues for inclusion of strategies in teacher education programs that will equip teachers to be well-informed so as to play a more active role in children's knowledge construction and not just be a "transmitter of knowledge" (p. 18).

Being a multilingual country, NCF 2005 urges that it is imperative for teacher education in every Indian state to include language education by which the teacher should be equipped to teach in the local language of the state, the official Indian language (Hindi), and the global language (English). NCF 2005 stresses language education for teachers to enhance student performance in all subjects including mathematics. The document further states that teacher education should be "ongoing and onsite" with support in the form of adequate resources made available in every village, town, and city in the country (p. 39).

With respect to mathematics, NCF 2005 recognizes problems in school mathematics education and asserts that teachers lack the confidence, preparation, and support to teach the subject. Additionally, NCF 2005 critiques the current teacher education programs granting Bachelor of Education or Master of Education degrees as lacking inclusive environments and strongly recommends cultural, gender, and special needs sensitivity as part of teacher education curriculum (p. 107). As one of the major goals of NCF 2005 is revamping the existing curriculum, the document champions training teachers for curricular reform. Furthermore, NCF 2005 contends that teacher education should include a significant component of arts education applicable to all subjects, even mathematics. As a champion for quality and equality in education, NCF 2005 proposes equipping teachers with positive strategies to work with children with different abilities and inclusion of special education components in teacher education programs.

Teacher certification. NCF 2005 does not address teacher certification.

Professional development. Regarding the importance of adequate teacher preparation, for a subject like mathematics or science, for example, NCF 2005 advocates professional development for teachers that focuses on specific subjects and not "generic teacher training that does not provide understanding of content, of instructional techniques, and critical issues in mathematics education that is needed by classroom teachers" (p. 13). Emphasizing the requirement of teacher training for teacher quality, the document states that "quality of teachers greatly depends on procedures used for training" (p. 8) and that teacher training will help teachers equip themselves to increase student outcomes.

Further quotes in NCF 2005, like "In-service training can play a significant role in the professional growth of teachers and functions as an agent for change in school-related practices" (p. 111) and in-service training can be a "process and not an event whereby teachers receive two to three months of training once every five years" (p. 111), show the importance in the document of in-service training for teachers. NCF 2005 pays attention to pre-service teacher education and in-service teacher training and proposes the education and training be carried out systematically to get quality results from both teachers and students.

Additionally, NCF 2005 recognizes the faults in the current teacher education system and strongly recommends professional development for pre-primary, primary, and secondary grade teachers and states that "professionalization of teachers should be reflected in policies governing recruitment, pre-service, and in-service training and working conditions" (p. 102). Finally, the document proposes that teacher programs should have a provision for linking the pre- and post-training of teachers through the DIET within university-based institutions.

Non-traditional teacher quality variables. NCF 2005 makes no mention of the non-traditional teacher quality variables of teacher salary/performance pay, teacher qualification in mathematics, and teacher absenteeism.

Teacher attitude. NCF 2005 advocates a strong and positive student-teacher relationship with zero tolerance for corporal punishment by teachers. NCF 2005 talks at length about discipline and participatory management where it discusses the need for educating teachers to have a positive attitude. A teacher's good attitude and relationship with her or his students is required for a stress-free learning environment for students' overall growth (NCERT, 2005). Also, a motivated teacher will motivate students who do not seem to be intrinsically motivated (NCERT, 2005). Therefore, teachers should be trained and educated to discipline students with few rules and freedom of expression and thought, inculcating habits of self-discipline (NCERT, 2005). The document also highlights the need for academic and emotional support by teachers to enhance student learning.

Specific to mathematics, NCF 2005 proposes that mathematics teachers should have an attitude in class that portrays their belief that every child can learn mathematics, a subject that gives rise to anxiety in students. Teachers should possess an attitude to encourage every child to have an equal opportunity to learn and especially be sensitive to children who learn differently than others (NCERT, 2005). NCF 2005 advises schools to recruit teachers who have a background in guidance and counseling so that no child is unable to learn. NCF 2005 states, "A sensitive and well-informed teacher is able to engage children through well-chosen tasks and questions, so that they are able to realize their developmental potential" (p. 17).

Teacher accountability. NCF 2005 stresses teacher accountability and states that teachers should be accountable and responsive to the needs of children and "should view appraisal as a

continuous educative process" (p. 108). It also calls for a system for monitoring teaching carefully be put into place in every school. Stressing the importance of teacher autonomy and professional independence in enhancing teacher quality, NCF 2005 says that "teacher autonomy is essential for ensuring a learning environment that addresses children's diverse needs" (p. 98) and that a teacher, in order to enhance children's performance, needs autonomy and independence in her or his role. Thus, for systematic reforms in the education system, NCF 2005 recommends "preparing teachers and supporting their professional practice" (p. 111) and suggests giving teachers autonomy and independence in their teaching without much interference by the school heads as another way to improve teacher quality (NCERT, 2005).

Teacher quality discourse in 2009—NCFTE 2009. NCFTE 2009 developed the curriculum for teacher education with a vision to make much needed changes in the quality of teachers through teacher education. The framework highlights the context, issues, and contents of the curriculum for teacher education and stresses the need to treat teaching as a profession for which revamping of teacher preparation is an urgent need.

Traditional teacher quality variables.

Teacher qualification. NCFTE 2009 recognizes the symbiotic relationship between teacher quality and student outcomes and the need for academic and professional standards of teachers, which is apparent from the following text:

> The importance of competent teachers to the nation's school system can in no way be overemphasized. It is well known that the quality and extent of learner achievement are determined primarily by teacher competence and it is a common knowledge that the academic and professional standards of teachers constitute a critical component of the essential learning conditions for achieving the educational goals. (p. 1)

NCFTE 2009 clearly demarcates between teacher initial education and professional development. It argues that the initial teacher education plays an important role in the making of a teacher as it marks "the initiation of a novice entrant to the calling" of the profession (p. 2). NCFTE 2009 stresses the importance of direct human contact and social interaction among student teachers as the "core requirement for initial teacher preparation" (p. 17). The document repeatedly asserts the need for a sound and systematic teacher education program that should encompass the changing needs of society and be upgraded with innovative skills and practices.

Highlighting the issues with the current teacher education for both elementary and secondary school, NCFTE 2009 stipulates the ideal duration of teacher education as four years after senior secondary or two years after a bachelor's degree program, indicating that this "would provide enough time and opportunity for self-study, reflection and involvement, engagement with teachers, school, classroom and pedagogic activity and rigorous theoretical study" (p. 46).

Prior to explaining the curricular area of teacher education, NCFTE 2009 documents shortcomings of the current teacher education and its vision for a teacher and teacher education in India. First, it notes that the initial teacher preparation in India for elementary school teachers suffers from isolation, a low profile, and poor visibility in view of its being a non-degree program. NCFTE 2009 makes a valid observation here that the early years' education of children is crucial for the future of the individual and national development and, therefore, teachers at elementary levels should be especially well prepared and trained.

At the time of publication of NCFTE 2009, holders of a short-term diploma in education (D.Ed.) could teach at elementary schools in the country. Arguing that the short duration of the course failed to equip teachers with required pedagogical skills and training needed to understand children's psychological needs and facilitate their learning, NCFTE 2009, therefore,

suggests the need to upgrade the elementary teacher education system. In this regard, it cites "enhancing the entry qualification and duration of training making it equivalent to a degree program including variety of scholarship from the sciences, social sciences, mathematics and the languages" (p. 8).

Second, NCFTE 2009 stresses the need to strengthen secondary teacher education in terms of intensity, rigor, and duration. At the time of its publication, there was an excess of private colleges that provided sub-standard education and training to teachers, and the increase in numbers of such institutions needed to be curbed by strict regulations. Such institutions and programs do not prepare teachers to impart quality education and train teachers as only "transmitters" of knowledge (p. 11).

Third, NCFTE 2009 realizes that the one-year B.Ed. degree program lacked practical experience and proposes increasing the duration to two years to make it more relevant to the children's learning in the current transforming global situation. Fourth, teacher education in India is noted to lack professional preparation of teachers in the sense that along with knowledge, institutions need to produce reflective teachers with a passion for teaching and teachers who possess positive attitudes and skills (NCTE, 2009). This shows that an attempt is being made to search for the best teacher education program to improve teacher quality in today's transformative society.

While shaping the teacher education for the country, NCFTE 2009 also looks at teacher characteristics globally. NCFTE 2009's vision for teacher education keeps intact the Indian culture and values and yet takes into consideration good teacher education principles and ideas that are present globally. To this effect, the document purports that teacher education should be flexible with the changing times, empower teachers, and be "liberal, humanistic" (p. 19), and

responsive to individual children's needs. Also, teacher education should prepare teachers to understand how students learn and how to actively engage students in learning. Furthermore, teacher education should train teachers to critically examine textbooks rather than accepting them as given. Finally, NCFTE 2009 says that teacher education should enable teachers to understand that the responsibility of a teacher is not limited inside the classroom but extends beyond with the need to educate students as responsible citizens.

A strong component of the NCFTE 2009 is the curricular area of teacher education to improve the academic and professional standards of a teacher to achieve educational outcomes. Evidence of teacher education curriculum is, therefore, extensive in the document (see Figure 5). The NCFTE 2009 has a comprehensive framework for teacher education curriculum that includes every aspect of education, including the theoretical, practical, psychological, philosophical, and socio-economic, to bring about a positive change in teacher education. The document argues that teacher education has to cover a spectrum of areas for a quality teacher (p. 111). NCFTE 2009 explains that the teacher education curriculum framework is divided into three areas: Area A (Foundations of Education), Area B (Curriculum and Pedagogy), and Area C (School Internship).

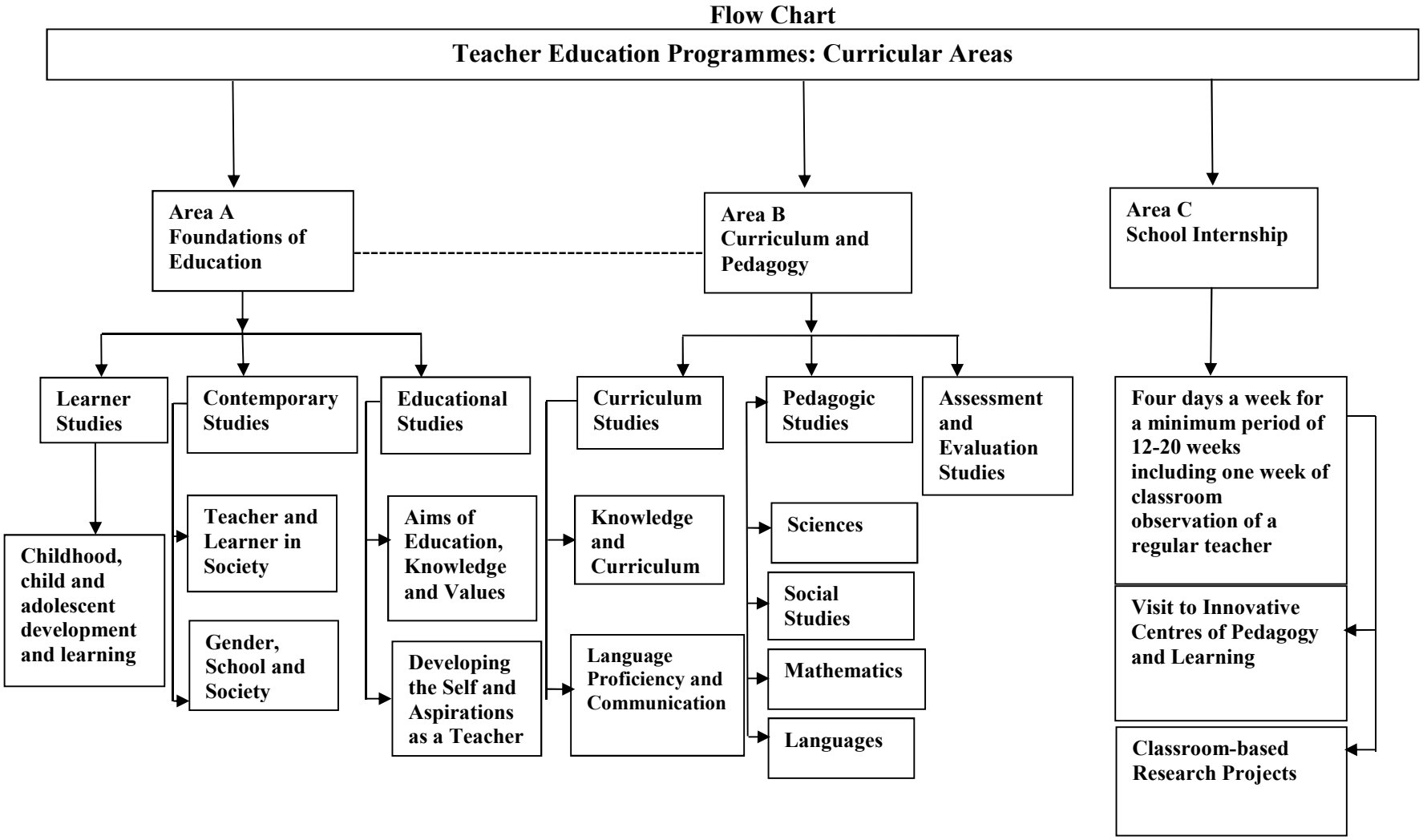

Figure 5. Curricular areas of initial teacher preparation in NCFTE 2009. Reprinted from NCFTE (2009, p. 27).

In Area A, Foundations of Education includes Learner Studies, Contemporary Studies, and Educational Studies, explained as follows:

- Learner Studies: NCFTE 2009 acknowledges that pre-service teacher education at all levels should be designed to study children and understand how they learn. For this, teacher education should include subjects like psychology, philosophy, and sociology that equip teachers with knowledge of children's learning and thinking at all age levels. The curricular includes two to three theory courses and a practicum.
- Contemporary Studies: Teacher education should generate awareness of human and child rights within the Indian society. Also, teachers should be educated to understand the classroom environment as a social context and the relationship of education to society and humanity. This curricular includes one to two theory courses, projects, seminars, and assignments.
- Educational Studies: Teacher education curriculum should include the meaning of education, its aims, values, and knowledge, and its relevance to children's learning. Through Educational Studies, teachers should be provided with a firm foundation of educational theory and the practice of education. This curricular includes one to two theory courses with assignments, built-in field-based units of study, term papers, and presentations.

Area B of the curriculum includes Curriculum Studies, Pedagogic Studies, and Assessment and Evaluation Studies, explained as follows:

- Curriculum Studies: NCFTE 2009 rationalizes the need to include general education principles in teacher education to develop the conceptual foundation of

prospective teachers. Curriculum Studies engages student teachers with "epistemological and ideological assumptions about knowledge, learner, and learning; their implications for curriculum, pedagogy, and assessment in school education" (p. 28). The language component is also included in Curriculum Studies as a teacher's language proficiency and communication skills are critical factors in student learning. It includes four to six theory courses with recording and analysis of observations.

- Pedagogic Studies: The focus is to understand school subjects and their pedagogic approaches in the context of the learner and school. For example, instead of teaching basic computations in mathematics, the subject is made more relevant to the child through its usage in daily life. It includes four to six optional courses with a practicum.
- Assessment and Evaluation Studies: The idea is to expose student teachers to the history of evaluation and assessment and apply it not just to track students' outcomes but also their overall development. It includes one theory course with group and individual assignments and a practicum.

Lastly, Area C focuses on practical application of the theoretical aspect of teacher education. NCFTE 2009 recommends that every student teacher should have four days a week of practical teaching for between 12 to 20 weeks for both two-year and four-year degree programs. The document further adds that internships should be a partnership between the school and the student teacher, and schools should make resources available to the student teacher. The student teacher develops unit plans and maintains reflective journals under a mentor.

However, although the NCFTE 2009 carefully maps units that should be included in the teacher education curriculum, it states that "a teacher education curriculum framework needs to be in consonance with the curriculum framework for school education" (p. 111). This quote reaffirms the belief that teacher education curriculum should not be a static document, and teachers should be trained to rise to the demands of the learner. Also, with the NCFTE 2009 being a template for teacher education across the country, it should be adapted per individual state needs, keeping in mind the aims, goals, and values of the document. Believing teacher education curriculum to be relevant and a planned effort, NCFTE 2009 calls for "participatory curriculum planning involving all stakeholders, modular organizations of curriculum in terms of critically engaging with theory and bringing practice within its perspective and a professional approach" (p. 9).

Practicum courses are an integral part of the NCFTE 2009 teacher education curriculum, showing that for teacher quality to improve, hands-on experience helps with "learning to integrate ideas, experiences, and professional skills" (p. 38). To ensure that teacher education curriculum is systematically put together and research based, NCFTE 2009 advocates the need for research to document practices that can be included in the study for student teachers and also innovative strategies and models to be included in teacher education curriculum.

Thus, through a single model of teacher education curriculum, NCFTE 2009 includes all features to bring a desirable change in teacher education and an impact on the educational system in India. NCFTE 2009 documents the need to replace the teacher education model in place at that time, which was short in duration and low in planning and quality of teaching, with a model that "integrates general education with professional development along with intensive internships with schools" (p. 46). Appendix C has a comparison of a few key features of teacher practice in

place prior to NCFTE 2009 and teacher practice proposed at the time of publication of the curriculum framework.

Although the NCFTE 2009 creates an invaluable framework for teacher education, it realizes that the framework will remain just a document unless implemented by qualified, competent, and professional teacher educators. However, there is a shortage of qualified educators for teachers due to a lack of professional development for pre-school and elementary school teachers and inadequate design for post-graduate programs in education (NCTE, 2009, p. 75). To address the issue, NCFTE 2009 highlights the need for teacher educators and outlines their requirements. The document stresses the requirement of a minimum of a B.Ed. degree for elementary teacher educators and an M.Ed. for secondary school teacher educators. The aim is to have proficient teacher educators to educate and train teachers that have an impact on student development and learning.

Teacher certification. Teacher certification in India is obtained by a teaching certificate or short-term certificate course from authorized and recognized institutions like CENTA. In contrast, teacher qualification includes pre-service teacher education (e.g., degree or diploma courses) from private and public institutions recognized in India. NCFTE 2009 does not discuss teacher certification and the focus of the document is on teaching degrees and diplomas.

Professional development. Regarding a need for professionalization of teacher education in the country, NCFTE 2009 upholds "initial and continuing professional development to ensure adequate supply of professionally competent teachers" (p. 2) and development of "reflective teachers" (p. 15). In respect to training of teachers, NCFTE 2009 recognizes the need for activities and interactions that would contribute towards sustaining professional development.

The document notes that, as professional development is an important ingredient in enhancing teacher quality, currently there are many opportunities and avenues for such, with varying degrees of motivating teachers and improving student outcomes. Professional development still lacks adequate management and compromises on treating teaching as a profession. NCFTE 2009 strongly recommends careful planning and designing of in-service or professional development training and recommends certain routes towards teachers' continuing professional development.

First, there can be short-term and long-term courses, ranging between four to five days and up to three months, on specific teacher topics to enable teachers to strengthen their knowledge in any area. Second, teachers can be trained on using distance media like the internet that acts as a resource for ideas and for wider dissemination of knowledge with professionals worldwide. Third, teachers can be encouraged to take a sabbatical year for study and research that will assist them in enhancing their teaching in class for the betterment of student learning. Fourth, teachers can be encouraged to attend conferences and meetings connected to the profession, with schools covering the expense. Fifth, schools can provide planned and professional workshops regularly for teachers based on teachers' needs and concerns and make available required resources for them. Sixth, teacher fellowships can be granted to teachers to enable them to work as faculty in colleges that are preparing future teachers. Finally, schools can provide the opportunity for exchange programs for teachers within the country and outside and utilize services of visiting teachers to enhance the quality of learning in schools (NCTE, 2009).

Furthermore, NCFTE 2009 advocates certain mechanisms be put into place for professional development and for enacting the curriculum framework. One of the mechanisms it strongly recommends is resource centers or teacher learning centers (TLCs). These centers are

proposed to assist both pre-service training and professional or continuing education for teachers. Furthermore, a cluster of schools selected by the DIETs to place pre-service student teachers for internship can also be used for in-service or professional development for existing school teachers. NCFTE 2009 points out that the need and awareness for professional development gave rise to more than 500 DIETs previously, although no more than 75% of the institutions were functional at the time of publication with the reason being lack of qualified faculty to provide professional training or in-service training to teachers. NCFTE 2009, recognizing the need for expansion and reforms in professional development to enhance teacher quality and make it meaningful for the progress of children, recommends strengthening of Institutes of Advanced Studies in Education (IASEs) that are responsible for in-service training of secondary teachers and making them responsible for professional development of elementary teachers as well.

Non-traditional teacher quality variables.

Teacher salary/performance pay. Apart from stating that the quality of a teacher includes teachers' status, remuneration, conditions of work, and their academic and professional education and that violation of any of the above factors could impact teacher quality (p. 2), NCFTE 2009 makes no other comment on teacher salary or performance pay.

Teacher qualification in mathematics. NCFTE 2009 does not discuss in detail teacher subject-matter competency, though it does mention that specific subject training for teachers is a part of the curriculum framework.

Teacher absenteeism. NCFTE 2009 does not address teacher absenteeism.

Teacher attitude. NCFTE 2009 stresses the positive attitude that teachers have to possess, apart from initial and on-going teacher education and professional development. It purports that a teacher in today's global world "must be equipped not only to teach but to understand children"

(p. 2). Like the NCF 2005, NCFTE 2009 also mandates that a teacher should refrain from any form of corporal punishment and be a facilitator of children's learning, helping students "construct knowledge and meaning" and not just be "givers" of information (p. 3) while displaying an encouraging attitude towards their students.

Teacher accountability. With respect to teacher autonomy, NCFTE 2009 asserts that teachers should play an active role in designing textbook content and curriculum to improve the learning outcomes of the students. NCFTE 2009 talks about teacher autonomy in the form of preparing teacher education programs to inculcate responsibility towards student learning.

Teacher quality discourse in 2016—NPE 2016. NPE 2016, a guiding document of the policies of the Central Government, critically recognizes the importance of quality education for the social, economic, and political growth of the country. To this effect, it states, "[A]n education system built on the premises of quality and equity is central to the sustainable success in the emerging knowledge economy" (p. 1). Apart from quality education, the discourse on teacher quality is present in NPE 2016. The document recognizes that teachers are the pivot point around which the education system of the country revolves, and quality of the teachers needs to be increased to improve quality of education.

Traditional teacher quality variables.

Teacher qualification. Focusing on the importance of quality teachers in school education, the draft of NPE 2016 states its mission is to "foster quality education with a strong focus on … teacher quality and performance" (p. 14). Similar to the NCFTE 2009, NPE 2016 blames the poor quality of education in the country on poor teacher quality resulting from inadequate teacher education and training. It is evident that the policy is seriously looking at strengthening teacher education as it states that "it will be mandatory for all teacher institutions

such as DIETS, B.Ed., etc. to be accredited and benchmarking standards will be set up for block resource centers" (p. 29).

The policy recognizes that the education system in India has paid a heavy price for neglecting teacher education and training. Therefore, placing strong emphasis on teacher education, NPE 2016 recommends following the NCFTE 2009 benchmark of a four-year integrated Bachelor of Arts/Bachelor of Science/Bachelor of Education and further proposes the possibility of a five-year integrated program after tenth grade for elementary teachers and after twelfth grade for secondary teachers. The policy strongly advocates making the four-year integrated course mandatory in all states. The expectation is that such a policy will give the students the chance to be sure of their choice of the teaching profession and thereby increase content knowledge and teacher quality. Furthermore, the policy recommends that the entry to the B.Ed. degree should have a benchmark minimum requirement of marks of 50% or greater at graduation. The policy aims for this to give the students the chance to be sure of their choice of the teaching profession and thereby increase content knowledge and the teacher quality.

NPE 2016 addresses teacher quality within the context of the significant changes that are in the current education system. NPE 2016 recognizes that teaching is no more confined to the classroom, and students have access to new knowledge. The authors of NPE 2016 want to "guide the new renewal process in India" (p. 5). Thus, to equip teachers to efficiently carry out their duties, NPE 2016 proposes mandatory teacher training, a 4-year integrated teacher education program that includes research, innovation, and experimentation, and links between teachers accountable for student learning outcomes to improve teacher quality. To ensure that qualified and competent teachers are employed in schools, the policy advises states in the country to have separate teacher recruitment boards, approved by the Central Government.

With respect to teacher education curriculum to prepare teachers, NPE 2016 advises integration of information and communication technologies (ICTs) as part of teacher education curriculum to enhance teaching quality. Discussing the need to prepare teachers to handle the dynamics of the current demands of education, the draft of NPE 2016 states that the "role of teachers will be redefined to promote adoption of a blended model of pedagogy with a combination of self-learning, practical and collaborative learning components" (p. 39). Additionally, the NPE 2016 recommends linking teaching to research to enhance teacher quality in the country.

Teacher certification. NPE 2016 recommends teacher certification or licensing once every ten years to keep abreast of new additions in teacher education.

Professional development. Recognizing the importance of in-service training for teachers, the NPE proposes use of information technology to train teachers and keep them abreast of teaching strategies and techniques from around the world. Further, NPE 2016 calls for "mandatory in-service training for all teachers once in every three years" (p. 30), revealing that it is affirming earlier policies on requisite teacher training to improve teacher quality. The policy suggests that current teachers in government schools who are working towards getting their B.Ed. degree should be provided regular in-service training to improve the quality of teaching.

Additionally, the authors of the policy are of the opinion that, although the number of SCERTs and DIETs that provide professional training to teachers is increasing, there is a lack of adequately qualified and trained teacher trainers. The policy, therefore, advocates that teacher trainers should have the same qualifications as college lecturers (doctorate degree) and be paid on a similar pay scale.

Non-traditional teacher quality variables.

Teacher salary/performance pay. NPE 2016 remarks that in many states in the country, a system of correlation between teacher monetary incentives and performance is lacking, which demotivates the teacher, thus affecting school education. Therefore, the NPE 2016 calls for "effective monitoring of teacher performance, with built in incentive systems like extra incentives based on teacher performance" (p. 41).

Teacher qualification in mathematics. NPE 2016 recognizes the importance of subject-matter competency and, though not elaborating much, states that "[t]he four year integrated B.Ed. course will be strong in subject content" (p. 179).

Teacher absenteeism. NPE 2016 advocates appropriate mechanisms to prevent teachers from being out of the class. It is noted that during elections, many political parties use teachers to help with their administrative work, resulting in teachers not being in the class to teach. This impacts the quality of education and the learning outcomes. The NPE 2016, therefore, wants to prevent political interference in the teaching duties of the teacher through appropriate management measures. Some states are noted as trying to control teacher absenteeism through bio-metric attendance recording, but the situation in the country is noted to need a lot of attention (p. 133).

Teacher attitude. NPE 2016 specifies that teachers should possess positive attitudes towards children and their learning, especially with children with special needs. The policy specifically states that teachers should actively involve children in their learning and play the role of facilitators and mentors**.**

Teacher accountability. NPE 2016 clearly articulates the need for teacher accountability for learning outcomes, which is clear from their quote, "Programmes for enhancing the capacity, motivation and accountability of teachers to deliver quality education and improvements in

learning outcomes of students will be accorded priority" (p. 30). Additionally, to ensure teacher accountability, the draft states that "periodic assessment of teachers in government and private schools will be made mandatory and linked to their future promotions and increments" (p. 30).

Quantitative Phase

To analyze the influence of both the traditional and non-traditional teacher quality variables on student performance in mathematics, correlation and multiple regression methods of analysis are used. A correlation analysis shows the direction and strength of the relationship between teacher variables, both traditional and non-traditional, to student performance in mathematics, and multiple regression assists in examining the relationships between the various independent teacher variables and the dependent variable, student performance in mathematics. The results aid in testing the hypotheses governing the study. The quantitative phase is divided into three sections: preliminary data analysis, primary data analysis, and results.

Preliminary data analysis. The data collected from the PISA 2009 for the two states of QHP (Himachal Pradesh) and QTN (Tamil Nadu) in India were first filtered in SPSS, choosing all the student variables from the student data files and the teacher quality variables (traditional and non-traditional) from the school data file. Thus, the two generated SPSS files (student data file and school data file) were merged using SPSS into one consolidated file with relevant teacher quality variables. This customized merged file was used for all the analyses. SPSS script was generated by the IEA's IDB Analyzer (IEA 2013) in order to account for appropriate weighting and jackknifing procedures (Neuschmidt, 2017). PISA 2009 testing uses plausible values to report student performance to assess knowledge or skills of a population. The IDB Analyzer first produces an SPSS syntax, which takes into account sampling weights and plausible values reported in PISA 2009. Then, by using this syntax, SPSS conducts a multiple

regression analysis and estimates regression coefficients for independent variables, which predict dependent variables, especially when the dependent variables consist of several plausible values, like in PISA 2009 (IEA, 2013).

The following section highlights the descriptive statistics for the dependent mathematics scores and independent teacher quality variables.

Descriptive statistics.

Dependent Variable (DV)—Mathematics scores. The research questions in the study are analyzing influence of teacher quality variables from the PISA 2009 questionnaire on student mathematics scores.

The mathematics literacy scores are the dependent continuous variables that are available for all 4,826 students from India that participated in PISA 2009 testing. The average plausible mean is 341.32, showing India's performance in 2009 was way below the OECD average score of 496. Any score below the OECD average of 496 is considered low (OECD, 2009).

Independent teacher quality variables. The 2009 PISA questionnaire has data on predictor teacher quality variables, both continuous and categorical, that assist in answering the research questions, and their parameters are highlighted below.

For RQ2a, which asks "Which traditional teacher quality variable is significantly associated with student performance in mathematics?," there are three continuous independent variables, one categorical independent variable, and the dependent mathematics score that assist in answering the research question.

The independent traditional teacher quality variables are *Full Time, Fully Qualified Teachers* (SC09Q31), *Full Time, Fully Certified Teachers* (SC09Q21) and *Part Time Teachers* (SC09Q22 and SC09Q32 merged together).

Full Time, Fully Qualified Teachers (SC09Q31) reflects the number of teachers who are employed full time by the school and are fully ISCED5A qualified. Data for this variable is available from 196 schools and data is missing/not available for 17 schools from the 213 schools that participated in PISA testing (Mean = 17.75, SD = 17.14). The minimum and maximum values range from zero to 120.

Full Time, Fully Certified Teachers (SC09Q21) reflects the number of teachers who are full time employed by the school and are certified by the appropriate authority. Data for this variable is available from 185 schools, and data is missing/not available from the remaining 28 schools (Mean = 29.85, SD = 24.87). On average, there are 30 teachers that are full time and fully certified. The minimum and maximum values range from zero to 185.

Part Time Teachers (SC09Q22 and SC09Q32) reflects the teachers who are part time employed by the school and are fully ISCED5A qualified and part time teachers employed by the school and are fully certified by the appropriate authority. Data is available from 160 schools and data is missing/not available from 53 schools (Mean = 1.03, SD = 3.71). On average, there is just one teacher per school that is part time and fully certified and part time fully qualified. There are 138 public schools and 75 private schools that participated in PISA 2009 from the Indian provinces of Himachal Pradesh and Tamil Nadu. Public schools in India are not allowed to keep part time teachers to teach core subjects and that could be one reason for the missing data (OECD, 2009).

Professional Development (SC26Q01) is a categorical variable that is recoded as *Yes* equals 1 and *No* equals 0 (*Quite often* and *Very often* = *Yes* (1), *Never* and *Seldom* = *No* (0)). This variable is used to indicate how often the school provides professional development activities to teachers according to the school goals. The frequency distribution shows 4,495

responses (100 valid percent), and there are 331 missing/not available responses. The number of *No* responses is 408 (9.1 valid percent) and the number of *Yes* responses is 4,087 (90.9 valid percent).

The next section highlights vital parameters for the non-traditional categorical independent variables useful in answering RQ2b.

For RQ2b, which asks "Which non-traditional teacher quality variable is significantly associated with student performance in mathematics?," there are four categorical independent variables and the continuous dependent mathematics score that will assist in answering the research question.

The independent variables are *Teacher Absenteeism* (SC17Q06), *Teacher Qualified in Mathematics* (SC11Q02*), Poor Student-Teacher Relationship* (SC17Q03), and *Teachers being too Strict with Students* (SC17Q11). *Teacher Salary/Performance Pay* has not been included in regression analysis because it is more administrative in nature and is not a true representation of teacher quality.

Teacher Absenteeism (SC17Q06) is a categorical variable that is recoded as *Yes* equals 1 and *No* equals 0 (*To some extent* and *A lot* = *Yes* (1), *Not at all* and *Very little* = *No* (0)). This variable is used to indicate to what extent the learning of the school is hindered by the variable. The frequency distribution for this variable shows 4,307 responses (100 valid percent) and missing/not available responses are 519. The number of *No* responses is 4,174 (96.9 valid percent), and the number of *Yes* responses is 133 (3.1 valid percent).

Teacher Qualified in Mathematics (SC11Q02) is a categorical variable that is recoded as *Yes* equals 1 and *No* equals 0 (*To some extent* and *A lot* = *Yes* (1), *Not at all* and *Very little* = *No* (0)). This variable is used to indicate to what extent learning of the school is hindered by the

shortage of teachers qualified in mathematics. The frequency distribution for this variable shows 4,371 responses (100 valid percent), and there are 455 missing/not available responses. The number of *No* responses is 3,911 (89.5 valid percent), and the number of *Yes* responses is 460 (10.5 valid percent).

Poor Student-Teacher Relationship (SC17Q03) is a categorical variable that is recoded as *Yes* equals 1 and *No* equals 0 (*To some extent* and *A lot* = *Yes* (1), *Not at all* and *Very little* = No (0)). This variable is used to indicate to what extent the learning of the school is hindered by poor student-teacher relationships. The frequency distribution for this variable shows 4,353 responses (100 valid percent), and there are 473 missing/not applicable responses. The number of *No* responses is 3,288 (75.5 valid percent) and the number of *Yes* responses is 1065 (24.5 valid percent).

Teachers being too Strict with Students (SC17Q11) is a categorical variable that is recoded as *Yes* equals 1 and *No* equals 0 (*To some extent* and *A lot* = Yes (1), *Not at all* and *Very little* = *No* (0)). This variable is used to indicate to what extent the learning of the school is hindered by teachers being too strict with students. The frequency distribution for this variable shows 4,353 responses (100 valid percent), and there are 473 missing/not available responses. The number of *No* responses is 3,615 (83 valid percent) and the number of *Yes* responses is 738 (17 valid percent).

The next sections discuss the outliers, missing data, and the multicollinearity assumption test before moving to primary data analysis.

Outliers. Outliers are data points that are well below or well above the other data points for the variable (Pallant, 2010). Outliers can impact the analysis and have to be eliminated. SPSS has many ways to check for the existence of outliers and I used the measure of Standard residual

and the Cook's Distance rule, as the study uses regression analysis to test hypotheses (Field, 2014). The Cook's Distance shows the influence of a single data point on the regression analysis model of the study. The case-wise diagnostics in SPSS calculate the values of the measure of Standard residual individual (S) and Cook's Distance for plausible dependent mathematics scores (pvmath1, pvmath2, pvmath3, pvmath4, and pvmath5) with the teacher quality variables. If the standard residual is >|±3| and the Cook's Distance is >|1|, the outlier needs to be eliminated (Field, 2014). There were a few outliers based on the Standard residual; however, they were no influential cases according to Cook's Distance. Therefore, I did not eliminate any outliers in the study.

***Missing data*.** Missing data is the absence of values for one or more variables in a dataset. The missing data in the study can be the result of questions not answered in the school and student questionnaire, questions wrongly answered, or answers that are not applicable (Pigot, 2001). The PISA dataset 2009 for the school and student variables denotes missing data. While running correlation and regression analysis on the IDB analyzer, I selected the listwise option so that only a complete set of data is included.

***Multicollinearity*.** Prior to testing the hypotheses in a study, the absence of multicollinearity between predictor or independent variables needs to be determined. Multicollinearity was checked in this study through the Variance Inflation Factor Analysis test (VIF) in the SPSS software. The VIF value indicates whether the independent variables have a strong linear relationship with other independent variables (Field, 2014). For the study, a value of VIF less than 10 is considered an absence of multicollinearity (Field, 2014). The VIF and Tolerance values are reported later in this chapter for each multiple regression equation in Table 9 and Table 10 for all predictor variables.

As reported in Table 9 and Table 10, the VIF is less than 10. Therefore, the study does not run the risk of multicollinearity. The IDB analyzer was then used for correlation and regression analysis as shown in the next section.

Primary data analysis. Correlation and multiple regression analyses were conducted using SPSS and the IDB analyzer on the variables to test the hypotheses. Table 8 shows the correlation between predictor or independent variables and mean mathematics scores.

Table 8

Pearson's Correlation between Predictor Variables and Mean Mathematics Scores

Predictors	Correlation	Sample Size N
Full time, fully qualified	0.22**	4184
Full time, fully certified	0.18**	4280
Part time teachers	0.13**	2135

**$p < .01$

***Correlation analysis*.** Correlation analysis was conducted to assess the relationship between the continuous independent variables and student performance in mathematics as denoted by pvmath. There was a small but positive correlation between full time, fully certified teachers and student mathematics scores ($r = 0.18$; $p < .01$). Similarly, there was a small but positive correlation between part time teachers and student mathematics scores ($r = 0.13$; $p < .01$). There was a slightly stronger association between full time, fully qualified teachers and student mathematics scores ($r = 0.22$; $p < .01$).

***Multiple regression*.** Multiple regression analysis was conducted using the IDB analyzer. There are three hypotheses in the study. Accordingly, three models are formulated to test the three hypotheses. Model one includes only the traditional teacher quality variables and tests H2a for RQ2a. Similarly, model two includes all the non-traditional teacher quality variables and tests H2b for RQ2b. Finally, a third model combining all the traditional and non-traditional teacher

quality variables is used to test H2c for RQ2c. The following section restates H2a with its multiple regression results, H2b with its multiple regression results, and H2c with its multiple regression results.

Hypothesis 2a. This hypothesis states the following:

H2a: Of the traditional teacher quality variables, student performance in mathematics is most strongly related to professional development of teachers.

This hypothesis suggests that among the traditional teacher quality variables, professional development has a significant association with student performance in mathematics. Model one has all the traditional teacher quality variables, which were simultaneously run in one equation. Literature review shows that professional development affects teachers' content knowledge and teaching practices, thus significantly improving student achievement (Polly et al., 2015; Wenglinsky, 2012). Therefore, to test the hypothesis and show that professional development is an important teacher quality variable in the traditional teacher quality variable category, model one includes only the traditional teacher quality variables including professional development. The equation used in model one is as follows:

$$Y = B_0 + B_1 (\text{Full time, fully qualified teachers}) + B_2 (\text{Full time, fully certified teachers}) + B_3 (\text{Part time teachers}) + B_4 (\text{Professional development})$$

where Y is the dependent variable, which is the student performance in mathematics derived from the PISA 2009 database; B_0 denotes the constant; and B_{1to4} are the regression coefficients for the traditional teacher quality variables as shown in Table 9 below. Table 9 shows the results for model one for H2a from multiple linear regression analysis on the IDB analyzer.

Table 9

Multiple Regression Results Investigating the Association Between Traditional Teacher Quality Variables and Students' Mathematics Performance

Variable Names	*B*	S.E.	*ß*	*p* value	VIF
Constant	299.84				
Full time, fully certified teachers	-0.39	0.40	-0.12	.34	2.33
Full time, fully qualified teachers	1.45	0.51	0.35	**.03**	2.32
Part time teachers	1.38	1.18	0.10	.24	1.02
Professional development	34.16	13.84	0.08	**.01**	1.01

Note. R^2 = .11. N = 855. S.E. = standard error of the slopes. Bold numbers show significant p values.

In model one, presented in Table 9, multiple regression was conducted to analyze the relationship between traditional teacher quality variables (IV) and student performance in mathematics (DV). The combination of the four traditional teacher quality predictors explains 11% of the variance in student performance in mathematics (R^2 = .11). Among the four traditional teacher quality variables, full time, fully qualified teachers and professional development significantly contribute in predicting student performance in mathematics (p < 0.05). Specifically, controlling for the other traditional predictors in this model, as full time, fully qualified teachers increases by one unit, predicted outcome increases by 1.45 points. As teachers attend professional development activities per school goals, the predicted outcome increases by 34.16 points. To compare the importance across the four predictors, the beta weights ($ß$) suggest that full time, fully qualified teachers are most strongly related to the outcome.

Full time, fully certified teachers, an independent variable (IV), has a non-significant relation with the dependent variable (DV), mathematics performance (B = -.39; p = .34). The interpretation of these findings is that teacher certification in India is still an unexplored field. Although in India, the State and Central Governments have made it mandatory for teachers to have teaching certification from CENTA, private schools do not necessarily follow the

guidelines. Teachers can get certification from private unrecognized sources and such certified teachers still get recruited by private schools, leading to low student outcomes.

Full time, fully qualified teachers (ISCED5A), an independent variable (IV), has a significant relation to mathematics performance (DV). The *B* value of 1.45 and the corresponding *p* value of .03 explains that as the number of full time, fully qualified teachers increase by one unit, the predicted mathematics scores increase by 1.45 units. The results are not surprising, as amongst all the traditional teacher quality variables, literature review supports the fact that qualified teachers have shown increased student outcomes because of the increased teacher knowledge (Muralidharan & Sundararaman, 2011). The equivalent to ISCED5A qualification in India is the Bachelor of Education (B.Ed.), and more and more schools in India are recruiting teachers with a B.Ed. degree from recognized institutions.

Part time teachers include part time teachers that are fully certified and part time teachers who are fully qualified (IV) that are shown to have a non-significant influence on student mathematics scores (DV) at $p < .05$ ($B = 1.38$; $p = .24$). The contribution of part time teachers both certified and qualified in predicting mathematics performance in this model is low.

Results show that professional development (IV), a traditional categorical teacher quality variable, has a significant positive relationship with mathematics performance (DV) ($B = 34.16$; $p = .01$). The *B* value of 34.16 and the corresponding *p* value of .01 explain that as professional development increases by one unit, the predicted mathematics scores increase by 34.6 units. This suggests that when professional activities for teachers are conducted according to the schools' goals, there is a favorable increase in student outcomes.

Thus, the results from model one contradict the hypothesis as amongst the four traditional teacher quality variables, full time, fully qualified teachers and not professional development is

most strongly related to student outcomes.

Hypothesis 2b. This hypothesis states the following:

H2b: Of all the non-traditional teacher quality variables, teacher absenteeism is most strongly related to student performance in mathematics.

This hypothesis argues that among the non-traditional teacher quality variables, teacher absenteeism has a significant relation with student performance in mathematics. Literature review shows evidence in support of this claim. Teachers who remain out of the class or school have been shown to significantly affect student performance, especially in a subject like mathematics that requires daily practice and teacher guidance (Finlayson, 2009; Miller, 2012; Porres, 2016). To test this hypothesis, model two includes only the non-traditional teacher quality variables including teacher absenteeism. The equation used in model two is as follows:

$Y = B_0 + B_1$ (Teacher absenteeism) + B_2 (Teacher qualified in mathematics) + B_3 (Poor student-teacher relationship) + B_4 (Teachers too strict with students)

where Y is the dependent variable, which is the student performance in mathematics derived from the PISA 2009 database; B_0 denotes the constant; and B_{1to4} are the regression coefficients for all the non-traditional teacher quality variables as shown in the Table 10 below.

Table 10

Multiple Regression Results Investigating the Association Between the Non-Traditional Teacher Quality Variables and Students' Mathematics Performance

Variable Names	***B***	**S.E.**	***β***	***p* value**	**VIF**
Constant	348.77				
Teacher absenteeism	-6.20	9.73	-.02	.50	1.13
Teacher qualified in mathematics	-19.68	13.03	-.08	.11	1.01
Poor student-teacher relationship	-13.05	10.86	-.09	.15	1.01
Teachers being too strict with students	8.56	8.30	.05	.27	1.01

Note. R^2 = .03. N = 2141. S.E. = standard error of the slopes.

In model two, presented in Table 10, multiple regression was conducted to analyze the relationship between non-traditional teacher quality variables (IV) and student performance in mathematics (DV). The combination of the four non-traditional teacher quality predictors explains 3% of the variance in student performance in mathematics (R^2 = .03). The R^2 value is very small, showing that the influence of the non-traditional teacher quality variables on student performance in mathematics is very low. Among the four non-traditional teacher quality variables, none of the non-traditional teacher quality variables significantly contribute in predicting student performance in mathematics, $p < 0.05$ thus contradicting the hypothesis that suggests teacher absenteeism is most strongly related to student outcome.

Teacher absenteeism (IV), a categorical variable, has a negative and non-significant relationship with student performance in mathematics (DV) (B = -6.20; p = .50). The results suggest there is no relationship between teacher absenteeism and student performance in mathematics, which is contradictory to what earlier studies have revealed about teacher absenteeism having an influence on student outcomes (Manswell Butty, 2001; Miller et al., 2008). However, most of the studies on teacher absenteeism and student performance in mathematics are cross-national studies not involving India.

Teacher qualified in mathematics, a categorical variable, has a negative and non-significant relationship with student performance in mathematics (B = -19.68; p = .11). The results suggest a weak association between a shortage of teachers qualified in mathematics and predicted mathematics scores. In India and in most developing countries the term "teachers' qualified in mathematics" is not clearly defined (Goldhaber & Brewer, 1997, 2000; Hill, Rowan, & Ball, 2005), and this could be one of the reasons for a weak association.

Poor student-teacher relationship, a categorical variable, has a negative and non-significant relationship with student performance in mathematics (B = -13.05; p = .15). Results are contradictory to previous research that shows a significant relationship between poor student-teacher relationship and predicted mathematics scores' decrease (Lee & Loeb, 2000).

Results of teachers being too strict with students, a categorical variable, show a positive and non-significant relationship with student performance in mathematics (B = 8.56; p = .27). Interpretation reveals that if teachers are strict with students, there is a possibility of a decrease in the predicted mathematics scores. This could suggest that disciplinary measures are not helpful in enhancing student outcomes.

Hypothesis 2c. This hypothesis states the following:

H2c: In India, performance of students in mathematics is significantly related more to non-traditional teacher quality variables than traditional teacher quality variables.

Hypothesis 2c suggests that the four non-traditional teacher quality variables have a significant relationship with student performance in mathematics in comparison to the traditional teacher quality variables. A regression equation combining all the traditional and non-traditional teacher quality variables was used to test H2c. The equation used in this model is as follows:

$Y = B_0 + B_1$ (Full time, fully qualified teachers) + B_2 (Full time, fully certified teachers) + B_3 (Part time teachers) + B_4 (Professional development) + B_5 (Teacher absenteeism) + B_6 (Teacher qualified in mathematics) + B_7 (Poor student-teacher relationship) + B_8 (Teachers too strict with students)

Table 11 outlines the multiple regression results for the combined variables of traditional teacher quality and non-traditional teacher quality to predict student mathematics performance. The R^2 for this model is .15 indicating that 15% of the variance in student performance in PISA

2009 is explained by traditional and non-traditional teacher quality variables. Full time, fully qualified teachers (p = .01) and professional development (p = .02) are significant predictors of student performance amongst the traditional teacher quality measures. In the non-traditional teacher quality measures, poor student-teacher relationship (p = .01) and teachers being too strict with students (p = .04) are significant predictors of student performance in mathematics. The combined model predicts full time, fully qualified teachers increase student performance by 1.48 points on average. For every additional occurrence of professional development according to school goals, the model also predicts student performance will increase by 54.13 points, holding all other variables constant. For student-teacher relationship, the model predicts that for every occurrence of a poor student-teacher relationship, student performance will decrease by 34.17 points. Finally, the model predicts student performance will increase by 18.28 units for every occurrence of teachers being strict with students.

Table 11

Multiple Regression Results Investigating the Combined Association Between the Non-Traditional Teacher Quality Variables and Students' Mathematics Performance

Variable names	***B***	**S.E.**	***ß***	***p* value**
Constant	287.30			
Full time, fully certified	.. -0.41	0.37	-0.14	.26
Full time, fully qualified	1.48	0.47	0.35	**.01**
Part time teachers	1.28	1.14	0.08	.25
Professional development	54.13	15.21	0.14	**.02**
Teacher absenteeism	8.82	8.94	0.02	.32
Teacher qualified in mathematics	-2.87	17.43	-0.01	.87
Poor student-teacher relationship	-34.73	9.31	-0.20	**.01**
Teachers being too strict with students	18.28	9.21	0.11	**.04**

Note. R^2 = .15. N = 849. S.E. = standard error of the slopes. Bold numbers show significant p values.

Full time, fully certified teachers (p = .26) and part time teachers (p = .25) were not significant predictors of student mathematics performance amongst the traditional teacher quality measures. In comparison, non-traditional teacher quality measures of teacher absenteeism (p = .32) and teacher qualified in mathematics (p = .87) were not significant predictors of student mathematics performance. To compare the importance across the two sets of predictors, the beta weights (β) suggest that more traditional teacher quality variables are significantly related to student outcomes than non-traditional teacher quality variables. Therefore, the results do not support H2c.

Summary of Qualitative Results

The in-depth analysis of NCF 2005, NCFTE 2009, and NPE 2016 shows that, although the three documents vary in the way they address the traditional and non-traditional teacher quality variables, they all propose improving teacher quality in India.

NCF 2005 is considered an important document in India's education system as it takes the first stance formally recognizing that the country needs to revamp its education system from one that focuses on rote learning and memorization to education that is relevant to the overall development of the child. The document is the first to start the conversation on "modernizing" the Indian education system, though its focus is on national integration and making education comparable throughout the country (p. 3). Giving utmost importance to teacher quality, NCF 2005 places "different demands and expectations on the teacher, which needs to be addressed both by initial and continuing education" (p. 11). It stresses good teacher quality in order to implement the changes to enhance student learning and the education quality in India.

The NCFTE 2009, formalized in 2010, takes into consideration the changes proposed by the NCF 2005. In an attempt to get competent teachers, it proposes looking at teacher education

curriculum through a holistic lens and recommends a teacher education curriculum that includes "integration of general education with professional development along with intensive internships in school" (p. 46).

NPE 2016 focuses on development of education in India, which needs to "evolve with the changing times and needs" (p. 5). The document proposes improving teacher quality by giving teachers autonomy and professional independence to make students competent in today's transformative society by making teachers accountable for learning outcomes.

The three documents clearly acknowledge that education is an important part of the society, which is changing or transforming, and to improve quality of education in India, teachers should be better equipped to handle the changes to improve student learning.

Summary of Quantitative Results

Correlation analysis and multiple regression were conducted on the traditional and non-traditional teacher quality variables separately. The R^2 value of the traditional variables in predicting the student mathematics performance is 11%, which is a moderate value as compared to the very low R^2 value of 3% revealed from the non-traditional teacher quality variables and student mathematics performance regression equation. Among the traditional teacher quality variables, full time, fully qualified teachers were significantly associated to student performance in mathematics while among the non-traditional teacher quality variables, none of the chosen teacher variables showed any significant association with student performance in mathematics. However, in the combined regression analysis, the R^2 for the combined multiple regression was 15%. The traditional teacher quality variables of full time, fully qualified teachers and professional development showed significant relation to student outcomes in mathematics and

non-traditional teacher quality variables of poor student teacher relationship and teachers being too strict with students were significantly related to student outcomes.

Chapter Five: Discussion

The previous chapter presented results from both the qualitative and quantitative methods for traditional and non-traditional teacher quality variables in relationship to student performance in mathematics. In this chapter, results are discussed, and conclusions, limitations of the study, and future recommendations or paths for this mixed methods study are presented. This chapter is divided into four broad sections: 1) a summary, where the results are discussed in conjunction with the research questions, 2) a conclusion, in which the results are integrated and connected to the existing literature review and theoretical framework, 3) the limitations of the study, and 4) recommendations for future research.

Summary

Literature review has shown that teachers play an important role in education quality and student outcomes (Azam & Kingdon, 2014; Darling-Hammond, 2000; Muralidharan & Sundararaman, 2011; Singh & Sarkar, 2012). The poor performance of Indian students on PISA 2009 testing has raised serious doubts on the quality of teachers in the country. Looking at a few chosen teacher quality variables based on literature review, theoretical framework, and available data from PISA 2009, the study seeks to examine how teacher quality is addressed by NCF 2005, NCFTE 2009, and NPE 2016 in India and also the influence of the various teacher quality variables on student performance on the PISA 2009 mathematics assessment.

In this mixed methods study, there are five research questions discussed. The first research question focuses on the three chosen policy documents from India:

> *RQ1a:* How do Indian national education policy documents frame traditional and non-traditional teacher quality variables in reference to student achievement gains?

The following sections discuss the coding results derived from Chapter Four in respect to both traditional and non-traditional teacher quality variables to understand how the policy documents frame the teacher quality variables.

Traditional teacher quality variables. Figure 6 shows that among the chosen traditional teacher quality variables, overall in each document, teacher qualification is the strongest category at 40% in NCFTE 2009. In NCF 2005 and NPE 2006, it is addressed at 13% and 3% of coded sentences, respectively. Overall in each document, the second strongest category is professional development at 23% in NCFTE 2009, 7% in NCF 2005, and only 1% in NPE 2016. Finally, teacher certification is the least dominant category in all the documents and mentioned only once in NCFTE 2009.

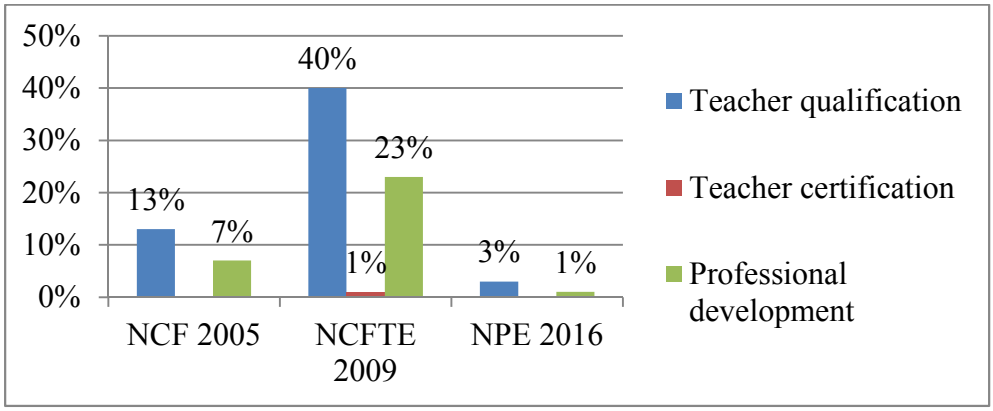

Figure 6. Percentage of sentences relating to traditional teacher quality variables in the policy documents.

The traditional teacher quality variables as coded in the three documents are discussed individually below.

Teacher qualification. This is the strongest category in all the three documents, at 13% in NCF 2005, 40% in NCFTE 2009, and 3% in NPE 2016. As shown in the Results chapter, all

three documents demonstrate evidence of discourse on teacher qualification as an important variable to improve teacher quality, though the percentage of focus differs.

The coded sentences pertaining to teacher qualification in NCF 2005 explain that the policymakers acknowledge that the teacher quality in the country is poor and that it also vastly impacted student performance. Twenty-three percent of the total sentences in NCF 2005 discuss teacher quality variables that are selected for the study, out of which 13% discuss teacher preparation pertaining to teacher qualification. NCF 2005 has a vision of how teacher education programs should be strengthened to improve student education. The major focus in the 2005 policy document is a child-centered approach to education, requiring major changes in the existing curriculum. To implement the curriculum, the 2005 policy document stresses teacher education as a key teacher characteristic for good teacher quality. A majority of the coded 13% of sentences on teacher qualification discuss the importance of the teacher's role in a student's cognition or achievement that can be active only if the teacher is well prepared through teacher education. The NCF 2005 document states that teacher qualification or a well-prepared teacher is seen as a key teacher quality variable to focus on to improve student gains.

Teacher qualification is again the most focused on category in NCFTE 2009 at 40%. The NCFTE 2009 and NCF 2005 documents are connected. NCFTE 2009 takes into account the changes proposed by NCF 2005 to improve teacher quality through revamping the teacher education curriculum and program. For the development of the entire teacher, the document states that teacher education should be "aimed at development of the total teacher knowledge and understanding, repertoire of skills, positive attitudes, habits, values and capacity to reflect" (NCFTE, 2009, p. 23).

With the increase in school enrollments and school development programs to achieve Universal Early Education, there has been an increase in the demand for teachers. The number of teacher education institutions increased, leading to commercialization of teacher education and low teacher quality. While NCF 2005 has a vision of how teacher education or teacher qualification in India should be, NCFTE 2009 takes a step forward by framing a comprehensive teacher education framework. NCFTE 2009 takes teacher quality as a serious national concern and proposes a framework that will produce qualified and competent teachers to enter the school workforce.

After NCF 2005 and NCFTE 2009, there was a nearly decade-long gap before formulation of NPE 2016. NPE 2016 is a comprehensive policy to guide education in the country. In NPE 2016, 3% of the coded sentences discuss the importance of teacher qualification in improving teacher quality. NPE 2016 argues that with the constant changes in the world, which the document terms as "transformative society" (p. 13), every teacher should be educated in the use of technology to encourage self-learning when required. This will improve the teacher's role as a facilitator for students rather than a giver of information. This approach to strengthen teacher education will improve the teacher quality in the country and keep teachers abreast with new strategies that teachers use globally.

Professional development. This category is the second strongest traditional category and the most dominant in NCFTE 2009 at 23% and the least dominant category in NPE 2016 at 1%. In NCF 2009, it stands at 6%. In NCF 2005, professional development for teachers includes pre-service teacher education and in-service teacher training, and although the document highlights the importance of professional development in teacher quality, there is limited discussion on the activities included in professional development. NCFTE 2009 focuses more on in-service

professional development for teachers. The document proposes various activities and teacher interactions both at local and international levels that are viewed as continuing professional development to enhance student achievement gains. Both NCF 2005 and NCFTE 2009 propose that professional development be carried out systematically and monitored by the IASEs and the DIETs in the country. Although professional development is the least dominant category in NPE 2016, the document notably proposes making in-service professional development compulsory to all teachers even in government schools once every three years and reaffirms the importance of professional development recommended by the earlier policies.

Teacher certification. This category was the least dominant of all the traditional categories, addressed by only 1% of sentences in NCFTE 2009 and NPE 2016. This category is ignored by NCF 2005. NPE 2016 recommends teacher certification for teachers in government and private schools be renewed every 10 years. The low percentage of existence of teacher certification in all the three policy documents shows that teacher certification is not considered a distinct teacher quality variable in the country.

The next section discusses the coded sentences relating to non-traditional teacher quality variables in the three policy documents.

Non-traditional teacher quality variables. The graph (see Figure 7) shows that discussion of all the non-traditional teacher quality categories varies between 0% to 3% in the documents. Teacher absenteeism and teacher accountability are the strongest categories in NPE 2016 at 3%. The second strongest categories are teacher accountability and teacher salary each at 2% in NCFTE 2009 and teacher attitude at 2% in NCF 2005 and NPE 2016. Overall, teacher qualified in mathematics is a weak category, which is ignored in NCF 2005 and mentioned in 1% of relevant sentences in NCFTE 2009 and 1% of relevant sentences in NPE 2016.

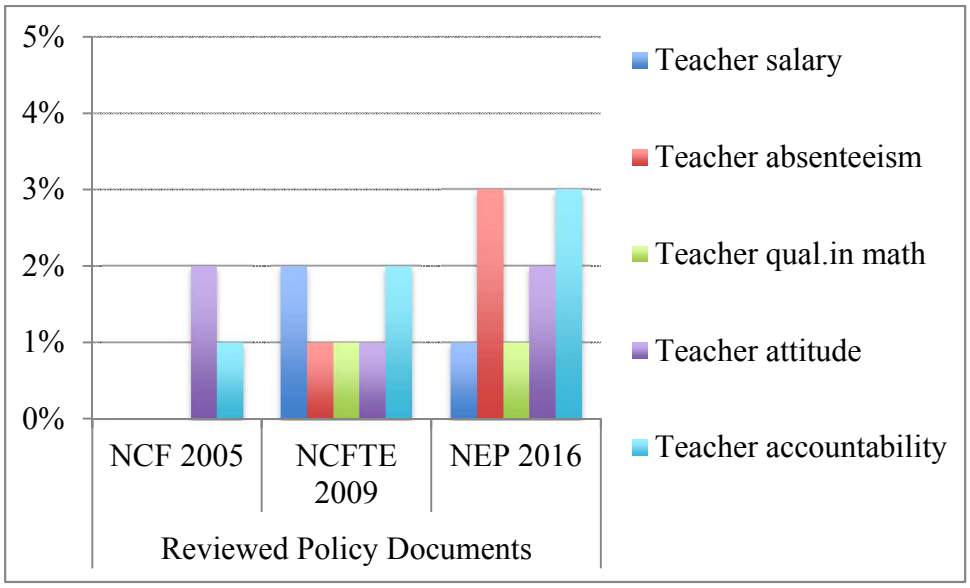

Figure 7. Percentage of sentences relating to non-traditional teacher quality variables in the policy documents.

Teacher salary/performance pay. This non-traditional teacher quality variable is not mentioned in NCF 2005 while it is mentioned at 2% and 1%, respectively, of the total material in NCFTE 2009 and NPE 2016. NCFTE 2009 briefly mentions this variable when proposing more incentives to qualified and committed teachers based on their performance. NPE 2016 highlights that there is no reliable system correlating teacher performance with teacher salary and "recommends effective monitoring of teacher performance with built-in incentive systems" (Government of India MHRD 2016a, p. 41). However, there are no further guidelines or measures presented in the document.

Teacher absenteeism. While NCF 2005 ignores teacher absenteeism, it is addressed at 3% in NPE 2016 and 1% in NCFTE 2009. NPE 2016 discusses it as an essential variable to improve teacher quality. Interestingly, NPE 2016 highlights the fact that teacher absenteeism largely is connected to political interference in the country. Due to lack of supervision on teacher absenteeism and bureaucracy present in the government schools, many teachers remain absent

from their classrooms to perform external pre- and post-election duties. Therefore, NPE 2016 urges political consensus to curb teacher absenteeism and strict governance by school management to curb the issue.

Teacher qualified in mathematics. This category is weak, 0% to 1% in all the three documents. While NCFTE 2009 proposes professional training to increase teachers' subject-matter competency in mathematics, NPE 2016 takes a more structured outlook on the variable. NPE 2016 recommends subject-matter competency as a component of the teacher education program, which will enable teachers to have the skill and competency to teach subjects like mathematics and science. The weakness of this category could be due to the fact that the focus is much more on teacher qualification, and it is assumed and practiced in India that a teacher with a teacher qualification can teach any subject with subject-matter competency, which is not yet mandatory in the country.

Teacher attitude. This variable is addressed weakly in all documents as it is at 2% of the coded sentences in NCF 2005 and 1% each in NCFTE 2009 and NPE 2016. All three documents, however, do highlight the fact that a positive teacher attitude helps teachers assume the role of facilitators and mentors rather than being mere disciplinarians, and this improves student achievement.

Teacher accountability. The coded statements for teacher accountability increases gradually from NCF 2005 (1%) to NCFTE 2009 (2%) to NPE 2016 (3%). In NCF 2005, it is recommended that teachers be accountable for children's diverse needs and overall development. The focus then is not on academic learning outcomes. In contrast, one can see the change in NCFTE 2009 and NPE 2016 after the PISA 2009 testing. Then the documents recommend that teachers be accountable for student achievement or learning outcomes. In NPE 2016, the

category is strong as policymakers realize that teacher quality in the country is far from satisfactory and one way to measure or improve teacher quality is by holding teachers accountable for failure to achieve students' learning outcomes. For this to occur, the policy recommends learning outcomes for students be evaluated regularly through internal and external assessments (Government of India MHRD, 2016a).

The next research question highlights the shift in focus in respect to teacher quality variables, both traditional and non-traditional, in the policy documents from 2005 and 2016.

RQ1b: How did Indian national education policy shift from 2005 to 2016 in reference to traditional and non-traditional teacher quality variables and national competitiveness?

The following sections discuss that while the three documents recognize the importance of teacher quality in improving the quality of education in India and student achievement gains in the country, the significance of the individual traditional and non-traditional teacher quality variables in the documents varies from 2005 to 2016, as shown in Figure 8.

In the timeline, we can see that in NCF 2005, with respect to teacher quality variables, focus is more on traditional teacher quality variables of teacher qualification and professional development. It is important to understand that NCF 2005 came into existence in India at the time when the school education system in the country was controlled by internal high-stakes examinations that were textbook oriented, and the role of teachers was imparting information rather than facilitating learning (NCERT, 2005). The aim of the Indian education as quoted in NCF 2005 is to enhance the child's overall development and make learning more relevant to the student. To implement the child-centered curriculum which is the focus in NCF 2005, the document views teacher qualification as a prime teacher quality variable and professional development as an essential variable to improve teacher quality. In 2005, non-traditional teacher

quality variables were mostly ignored.

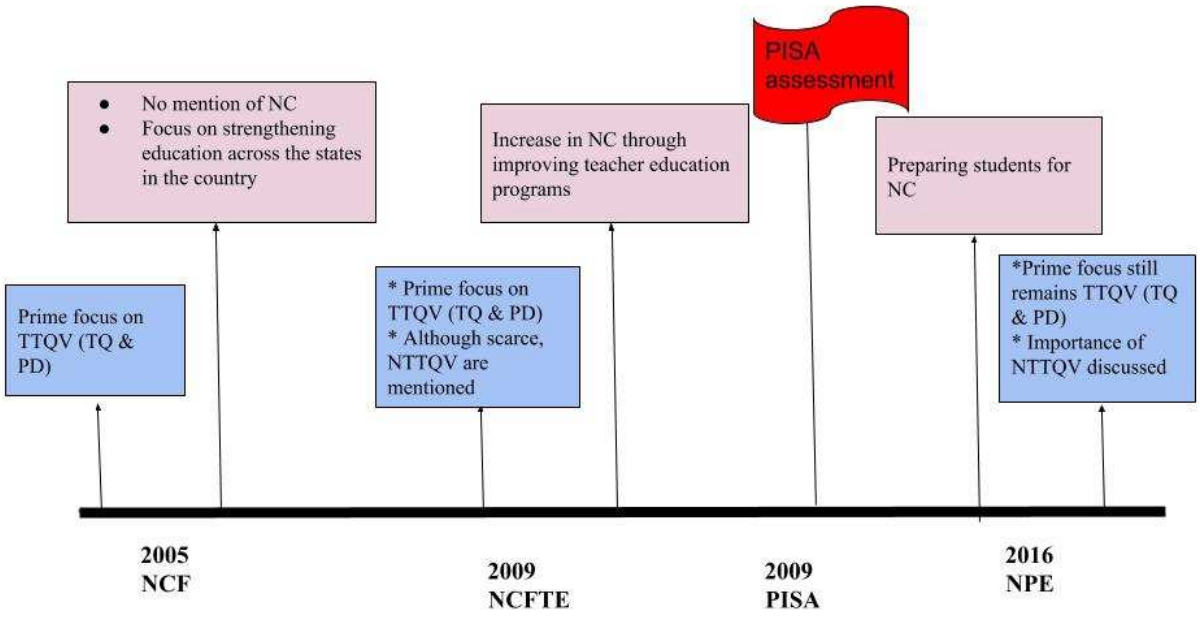

Figure 8. Timeline depicting shift in teacher quality variables and national competitiveness from 2005 to 2016.

Note. NC = National competitiveness, TTQV = Traditional teacher quality variables, NTTQV = Non-traditional teacher quality variables, TQ = Teacher qualification, PD = Professional development. Blue shapes are about the teacher variables and pink shapes about national competitiveness.

In respect to national competitiveness, the timeline highlights two important features in 2005. The first one is that the document does not mention the term "national competitiveness." Rather than emphasizing national competitiveness, NCF 2005 discusses strengthening the Indian school systems to make education in different states within the country comparable. The document envisions future changes in the education system in Indian society due to globalization and terms it as a "transformative vision of society." NCF 2005, therefore, justifies its focus on teacher qualification and continuing education or professional development in teacher education

programs that should be prepared for a shift from imparting mere theoretical information to disseminating practical knowledge.

As shown in the timeline, similarly to NCF 2005, NCFTE 2009 focuses the most on traditional teacher quality variables of teacher qualification and professional development. To give a concrete form to NCF 2005's vision of a teacher education program, NCFTE 2009 addresses teacher quality through a relevant comprehensive teacher curriculum. In respect to teacher education programs, justifying the need for a well-structured and planned comprehensive teacher education framework, NCFTE 2009 argues that "teaching is a profession and teacher education a process of professional preparation of teachers" (p. 15). Therefore, the document proposes increasing the duration and rigor of the teacher education programs along with practical experience to give it the status and quality of a "profession" (p. 8).

However, unlike NCF 2005, this document does not ignore the non-traditional teacher quality variables and briefly discusses the importance of teacher salary, teacher absenteeism, teacher attitude, and even teacher accountability. Although, the non-traditional teacher quality variables in the document are scarcely mentioned, the document in 2009 acknowledges the importance of these variables in improving teacher quality as compared to NCF 2005.

In respect to national competitiveness, NCFTE 2009 acknowledges that changes in teacher education will take place. It therefore justifies that preparing teachers through the planned curriculum framework will equip teachers to better prepare students to compete globally. To this effect NCFTE 2009 states that the teacher education and preparation programs need to take into account "the broader social, economic, and political changes taking place" (p. 2) in the changing society.

Thus, overall, the importance of traditional teacher quality variables in NCF 2005 and NCFTE 2009 remains most significant. However, in respect to non-traditional teacher quality variables, one can see a positive shift in the attention they get in NCFTE 2009 as compared to NCF 2005.

In between NCF 2005 and NCFTE 2009, India participated and fared poorly in the PISA 2009 testing. This created a shock wave in the country. Among other factors, teacher quality was blamed for the poor performance of Indian students. In NCF 2005, the document acknowledges low teacher quality, leading NCFTE 2009 to present a comprehensive teacher curriculum framework to improve teacher quality and, thereby, student performance.

Since PISA testing took place in the same year as NCFTE 2009 publication, it is difficult to gauge the effect of the implementation of NCFTE 2009 policy. However, the effects of both the NCF 2005 and NCFTE 2009 policy implications on teacher quality are visible in the NPE 2016.

PISA results of 2009 highlight India's poor education and teacher quality. Since 2009, the country has not participated in the subsequent PISA testing in 2012, 2015, and 2018. India is preparing to participate in the 2021 PISA testing, and, therefore, it is critical to see shifts in policy implications on chosen teacher quality variables in NPE 2016.

NPE 2016 takes a broader stand than NCF 2005 and NCFTE 2009 in respect to quality of education in the country. It stresses the need for implementation of the recommendations to improve teacher quality. The document clearly realizes that what was proposed by the earlier policies failed to make an impact on the education sector in India. It recognizes that, in spite of continued efforts by earlier frameworks and policies made for improving teacher quality, India's preparation and development of teachers is marked by deficiencies resulting in poor student

outcomes (Government of India MHRD, 2016a). It, therefore, proposes a Framework for Action for implementing and monitoring the initiatives.

With respect to teacher quality variables, one sees a shift in the focus of NPE 2016 from traditional teacher quality variables to non-traditional teacher quality variables. To a large extent, there is equal focus on both traditional and non-traditional teacher quality variables, specifically teacher qualification and teacher accountability. NPE 2016 also acknowledges the importance of other non-traditional teacher quality variables, including teacher salary, teacher absenteeism, teacher qualified in mathematics, and teacher attitude.

With respect to national competitiveness, NPE 2016 strongly advocates preparing teachers to use ICT, a global networking system in classrooms to keep abreast of the latest developments in education. NPE 2016 says that India is "at the cusp of major transformation" (p. 3), and every school in cities and villages will be well connected within the country and outside through technology. NPE 2016 argues that use of ICT will make the teacher education programs in India comparable to the rest of the world as ideas are exchanged globally. Thus, ICT will impact teacher qualification and continuing education or professional development. In regard to non-traditional teacher quality variables, ICT can be used to monitor teacher performance and make teachers accountable to student learning and also enhance teachers' subject-matter skills, which is still a neglected variable in NPE 2016. Teacher absenteeism will be monitored strongly through technology and thus controlled. Thus, NPE 2016 asserts that providing ICT in every school will transform the Indian education system, making it modern and competitive with the rest of the world "without compromising on India's traditions and heritage" (p. 118).

Finally, NPE 2016 continues recognizing teacher attitude as a critical variable in student achievement gains though it still remains a weak variable in 2016. As in 2005, NPE in 2016

recommends teachers to be mentors and refrain from any form of corporal punishment for students.

The next three questions relate to the quantitative data analyzed from the PISA 2009 database for India to reveal which of the teacher quality variables from the selected ones in the study are associated with student performance in mathematics.

To analyze significant variables from the traditional teacher quality variables, research question 2a states:

RQ2a: Which traditional teacher quality variables are significantly related to student performance in mathematics in India?

Results from multiple regression analysis show that, among the traditional teacher quality predictors, full time, fully qualified teachers ($p = .01$) is most strongly related to student performance in mathematics. Professional development ($p = .02$) is also significantly related to student performance in mathematics. In respect to full time, fully qualified teachers, results imply that teachers who are graduates with a B.Ed. degree and who are on the school payroll will help improve student achievement gains. This result adds to results from literature review for India and other countries that teachers who are qualified have the knowledge and expertise to influence student outcomes (Akiba et al., 2007; Ingersoll, 2007; Kingdon, 2006).

The significant association between professional development and student achievement gains implies that if professional development activities of teachers are conducted often, per the goals of the school, student performance in mathematics increases. The result is consistent with other studies that state the importance of professional development in reforming teacher quality to affect student performance. Professional development that is ongoing, intense, and curriculum based has shown to enhance teacher skills and knowledge to improve student

performance (Caena, 2011; Garet et al., 2001). However, literature review focuses a lot more on studies that stress the importance of the duration rather than content of professional development (Stewart, 2010). Studies on the influence of professional development on student outcomes are limited in India, and available studies state that there is no relationship between professional training and student outcomes (Azam & Kingdon, 2014). Therefore, the results of this study add important content to existing literature by showing how professional development activities for teachers conducted in tune with school goals will help improve student outcomes.

To analyze which non-traditional teacher quality variables are good predictors of student achievement gains, research question 2b states:

> *RQ2b:* Which non-traditional teacher quality variables are significantly related to student performance in mathematics in India?

In respect to non-traditional teacher quality variables, results from multiple regression analysis show none of the non-traditional teacher quality variables are significantly related to student performance in mathematics. However, when a combined regression analysis is conducted with both traditional and non-traditional teacher quality variables, a significant value (p = .04) for teacher attitude and specifically for teachers being too strict with students is revealed. This shows that if the teachers take certain disciplinary measures, student outcomes can improve. The results are surprising and contradictory to past studies indicating teacher attitude concerning disciplinary measures shows that students lose interest and motivation to perform well, resulting in low outcomes, as revealed by a study in Iran (Rahimi & Karkami, 2015). A significant and negative relation is also revealed between poor student-teacher relationship (p =.01) and student outcome. This result supports past studies that show positive demeanor and

relationship of a teacher with students can reduce mathematics phobia and anxiety, thereby improving student mathematics scores (Opdenakker & Damme, 2007).

The next research question compares both traditional and non-traditional teacher quality variables to see which variables influence student performance in mathematics.

RQ2c: How are traditional and non-traditional measures of teacher quality differently related to student mathematics performance in India?

The combined regression models for both traditional and non-traditional teacher quality variables highlight the relationship of the individual categories on student performance in mathematics. The R^2 value for the combined regression model is 15%, showing the percentage of variance in scores as explained by combined traditional and non-traditional teacher quality variables. While traditional teacher quality variables of full time, fully qualified teachers and professional development show a significant relationship with student mathematics scores, for non-traditional teacher quality variables, poor student-teacher relationship and teachers being too strict with students has a significant relationship with student mathematics scores.

Conclusion

India, a developing economy, participated in PISA 2009 international assessments and fared miserably. The news created a "shock wave" in the country and teachers were blamed for the low quality of education and poor student performance in the country. The study, therefore, analyzed the influence of teacher quality variables on students' mathematics performance in PISA 2009. The study's purpose is to provide information to policymakers in India, which may assist them in improving teacher quality in the country.

Literature review has termed certain teacher quality variables as "traditional," which are teacher qualification, teacher certification, and professional development. The study argues that

there is more focus in India on traditional teacher quality variables and other important variables that are "non-traditional" are ignored. To study the influence of traditional and non-traditional teacher quality variables on student mathematics performance, the mixed methodology using the PISA 2009 database is governed by the five research questions that are stated earlier in the chapter.

RQ1a. Results from the study show that the three policy documents, NCF 2005, NCFTE 2009, and NPE 2016, recognize the role of teacher quality in improving student achievement gains. However, the way they are framed and the focus on the various teacher quality variables varies in each document. NCF 2005 advocates the importance of strengthening teacher preparation programs in the country, and the document considers teacher qualification as a key teacher quality variable, followed by professional development, to influence student achievement gains. Most of the non-traditional teacher quality variables are not addressed by NCF 2005, although the document briefly addresses the importance of positive teacher attitude in influencing student achievement. NCF 2005 and NCFTE 2009 are connected together, and to give shape to NCF 2005's vision of a strong and progressive teacher education program, NCFTE 2009 frames a comprehensive teacher education framework. The document again looks at traditional teacher quality variables of teacher qualification and professional development as critical for improving teacher quality and student scores. Teacher certification is not addressed.

Within the non-traditional teacher quality variables, a new category that evolved during the coding process, teacher accountability, and its importance on student achievement are briefly highlighted in the document. The latest document included in the study is NPE 2016, where, although the focus continues to be on the traditional teacher quality variables of teacher qualification and professional development, the documents highlights the importance of the non-

traditional teacher quality variables. NPE 2016 urges the need to reform teacher quality to be on par with the rest of the world.

RQ1b. From 2005 to 2016, traditional teacher quality variables of teacher qualification and professional development continued to be the focus, though we can see a gradual shift towards the non-traditional teacher quality variables in 2016. PISA 2009 is not specifically mentioned in any of the documents. However, in respect to national competitiveness, in 2005, focus was on the country's education system across all states, although globalization and its accompanying changes were acknowledged. From 2009 to 2016, there was more talk about the changing economy or the "transformative world," the Indian education system, and the importance of teacher quality as well as how teachers and students need to be prepared to be a part of this ever-changing world.

RQs 2a, 2b, and 2c. Results from the correlation and multiple regression analysis reveal that combined regression analysis shows better results. Among the traditional teacher quality variables, full time, fully qualified teachers and professional development show significant relationship with student performance in mathematics. In respect to non-traditional teacher quality variables, both the influence of poor student-teacher relationship and teachers being too strict with students have a significant influence on student performance in mathematics.

Therefore, evidence from the mixed methods study shows that policymakers from 2005 to 2016 in India have focused more on traditional teacher quality variables than on non-traditional teacher quality variables. Teacher qualification and professional development have also shown significant influence on students' mathematics performance as shown in PISA 2009. In comparison, the non-traditional teacher quality variables are largely ignored in the documents. From the PISA 2009 data, the variable of teachers being too strict with students and poor

student-teacher relationship show significant relationship with student mathematics performance in the combined regression analysis.

The world culture theory explains the isomorphism between Western countries and a developing country, like India, in respect to linking teacher quality and student outcomes. As shown in the Results section of the paper, there is ample evidence in all the chosen documents to show that India recognizes that teacher quality is important for improving student scores and to enhance the quality of education in the country. The latest document, NPE 2016, specifically makes teachers accountable for student outcomes to improve teacher quality.

Furthermore, global discourse on quality teachers as an essential component of quality education, in which India is a participant, as well as reforms to strengthen teacher education as seen in the documents chosen for the study, show how India is seeking legitimacy on the world stage. In alignment with the Western countries, India is including in-service training as a necessary component of teacher preparation and professional training in specific core subjects like mathematics and science. Although India has not specifically defined the term *teacher quality* like some of the Western countries, evidence of focus on the select few categories of teacher qualification and professional development shows that the country is defining quality teachers as those who are professionally qualified and who undergo mandatory in-service training. This definition is narrow and needs to be extended to include the non-traditional teacher quality variable of teacher attitude, too.

Since 2016, one can see a gradual shift where policymakers are realizing the importance of non-traditional teacher quality variables since they are addressing them more than the earlier documents. The influence of the policy directives will hopefully be visible in future mathematics

assessments. Further research using more recent student mathematics scores is recommended to study the influence of this shift on student achievement gains.

Additionally, human capital theory explains the investment the Indian government is making in teacher education and training as a means for the country's growth. High quality teachers with credentials and training will raise the educational outcomes of students, thus increasing the country's human capital. As a country, India recognizes its huge untapped reservoir of productive and creative human capital. Quality teacher training and education will bring about huge gains in student learning and generate returns to the country. India is investing in teacher training institutions like DIETs, Colleges of Teacher Education (CTEs), and teacher curriculum as shown in NCTE 2009. However, it is important to note that while both the theories are looking at improving teacher quality, human capital theory looks at capital gain as a form of return in enhancing teacher quality, while there is no tangible return in world culture theory.

Limitations

The study findings are restricted by its limited scope and the nature of the variables. First, the teacher quality variables obtained from the PISA 2009 database are perception based as they are measured based on the views or opinions of the person filling out the survey. The data collected can be biased and without the support of empirical evidence and may not be a true representation of other states in India. Thus, the results from PISA 2009 cannot be generalized to the whole country other than the states of Tamil Nadu and Himachal Pradesh.

Next, the qualitative analysis relies on select variables from the PISA 2009 database. Although, I chose the dimensions of teacher quality that were suitable to the study and documents chosen, there are other non-traditional teacher quality variables that need to be included. In addition, there is a limited selection of documents, though the latest policy, NPE

2016, was included. Finally, I have restricted the study to analysis of policy without looking at the extent of inclusion/implementation of policy directives in the school/education system.

Recommendations

Despite the results of this study, I inherently continue to believe that the non-traditional teacher quality variables are also important in improving teacher quality and student achievement gains. Therefore, I have some recommendations to policymakers and researchers.

First, using similar methodology, I recommend future research to include quantifiable, and not perception based, non-traditional teacher quality variables to study the implications of teacher quality variables on student mathematics performance. Second, as the model with combined traditional and non-traditional teacher quality variables showed better results, I believe it would be advantageous for policymakers to specifically take a closer look at both these variables through additional evidence-based research rather than focus on just traditional teacher quality variables. Third, as an extension of this study, along with policy documents, the study should include and analyze teacher interviews, rather than surveys filled out by school authorities, to understand how the policies have facilitated improvement in teacher quality. Fourth, the five research questions of this study may be applied to data from 2018 Indian CBSE and ICSE results, which have been published recently, to see if these results persist for the new data set also. This may then lead to some clarity on the reasons for performance on PISA 2009 and provide some cues for teachers, educational administrators, and policymakers for introducing some changes into the current educational practice for better performance by the students on PISA 2021 in which India is participating.

Concluding Remarks

In spite of its limitations, this research has provided sufficient evidence to conclude that India recognizes the importance of teacher quality. The latest document, NPE 2016, is a positive step in improving teacher quality as it includes initiatives like research in teacher education, focuses on eliminating the loopholes present in the system, and highlights the importance of both traditional and non-traditional teacher quality variables in improving student outcomes. PISA 2021 will reveal the influence of the directives of NPE 2016 policy initiatives. India is hopeful of a desired change.

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Appendix A

Intercoder Reliability

Document	Total Sentences	Consistent Coded Sentences	Percentage of Consistently Coded Sentences to Total Sentences	Non-Consistent Coded Sentences	Percentage of Non-Consistently Coded Sentences to Total Sentences
NCF 2005	280	248	88.6 %	32	11.4 %
NCFTE 2009	104	86	82.7 %	18	17.3 %
NPE 2016	373	344	92.2 %	29	7.8 %
TOTAL	757	678		79	
Intercoder Reliability	89 %				

Appendix B

Table B1

Piloted Coding Scheme for Traditional Teacher Quality Variables

Category	Description	Coding Guidelines	Subcategory/Keywords
Transformative society is a common keyword to all the categories.			
Teacher Qualification	Teaching degree and diploma from recognized institutions	• Includes pre-service teacher education (e.g., degree or diploma courses) from private and public institutions recognized in India. Diploma or degree should be given to recipient. • Cannot include workshops or short-term courses conducted in schools. • Can include any changes in teacher education as a result of globalization.	**Degree:** Master of Education (M.Ed.), Bachelor of Education (B.Ed.), teacher qualification, teacher education, professional preparation **Diploma:** entry qualification, qualification, teacher preparation, student teacher
Teacher Certification	Teaching certification from authorized entities	• Can include teaching certificate or short-term certificate courses from authorized and recognized institutions. • Cannot include workshops or certificates from schools or online institutions not recognized by Central or State	teacher certification, short-term certificate courses, authorized institutions, acquired skills

		government.	
Professional Development	Workshops and training that assist teachers in improving their professional knowledge, competence, and skill	• Can include structured activities, workshops, training, and support that is given to teachers who already have teacher education (degree or diploma) or teacher certification. • Cannot include informal teacher meetings. • Includes research but not resources.	**In-service Training:** online training, on the job training, structured workshops **Professional Activities:** teaching centers/centers of learning, District Institutes of Education and Training (DIETs), Colleges of Teacher Education (CTEs), Institutes of Advanced Studies in Education (IASEs), State Councils of Educational Research and Training (SCERTs), training, guidance, practical experiences, resource centers, trainees, lectures, school follow-up, workshops, cluster-level (schools, meetings, etc.), teacher support

Table B2

Piloted Coding Scheme for Non-Traditional Teacher Quality Variables

Category	Description	Coding Guidelines	Subcategory/Keywords
Transformative society is a common keyword to all the categories.			
Teacher Salary/Performance Pay	Any monetary payment to teachers for services	• Cannot include personal gifts.	salary, performance pay, wages, increments, rewards, monetary incentives, monetary payment for services
Teacher Absenteeism	Teachers not present in class for an entire or partial day	• Cannot include vacancy. • Cannot include teacher shortage.	absent, out of class, access to school, attendance log, unpaid leave
Teacher Qualified in Mathematics	Teacher knowledge in the particular subject of mathematics	• Can include subject-matter expertise.	subject-matter knowledge, mathematics competency, mathematics skill, expertise
Teacher Attitude	Teacher demeanor towards students that affects outcomes	• Can include teacher encouragement. • Individual child focus. • Can include out of class support. • Can include remedial support.	**Teacher-Student Relationship:** engagement, individual support, remedial support, positive attitude, helping hand, encouragement **Teacher Disciplinary Measures:** strict, not encouraging

Table B3

Additional Teacher Quality Variable from NCF 2005, NCFTE 2009, and NPE 2016

Category	Description	Coding Guidelines	Subcategory/Keywords
Teacher Accountability	Teacher responsibility towards student learning	• Cannot include teacher attitude towards students.	Autonomy, responsibility, student/ teacher independence, teacher assessment

Appendix C

Teacher Education Before NCFTE 2009 Versus Teacher Education Proposed by NCFTE 2009

Practice of Teacher Education before NCFTE 2009 Publication	**Proposed Practice of Teacher Education**
Focus on psychological aspects of learners without adequate engagement with context	Understand the social, cultural, and political context in which learners grow
Knowledge treated as external to the student and something that has to be transmitted from teacher to student	Knowledge generated in the shared context of teaching, learning, and personal experiences through critical enquiry
Lack of sufficient student teacher internships	Planned and supervised internships proposed.
Short training schedule after general education	Sustained engagement of long duration
Subject-matter competency largely ignored.	Understand the need for subject-matter competency
Students' assumptions about social realities, the learner, and the process of learning are not addressed.	Students' own position in society and their assumptions are addressed as part of classroom discourse.

Note. Adapted from NCFTE (2009, p. 52).

Biography

PREETI KUMAR

Comparative and International Education Program
College of Education, Lehigh University
Iacocca Hall, 111 Research Drive
Bethlehem, PA 18015
Email: prk212@lehigh.edu

EDUCATION/ TRAINING

2013-2018	**Lehigh University** Ph.D. in Comparative and International Education	**Bethlehem, PA, USA**
2006-2010	**Georgia State University** M.Ed. in Behavior, Learning Disabilities and Autism	**Atlanta, GA, USA**
2007-2008	**Academy of Orton Gillingham** Teacher training program in spelling and reading	**Atlanta, GA, USA**
2004-2005	**SNDT Women's University** Post-Graduate Diploma in Management of Learning Disabilities	**Mumbai, India**
1988-1992	**University of Bombay** Bachelor of Commerce (B.Com.)	**Mumbai, India**
1983-1985	**Maharashtra State Board of Secondary & Higher Education** • Higher Secondary Certificate Examination • Senior Secondary School	**Mumbai, India**

SUMMARY OF QUALIFICATION

- Experience working with children who have different needs, and experience creating individual plans for them for school and home
- Familiar with the Reggio Emilia Approach to education
- Experience creating Individualized Education Plans (IEPs)

- Proficient in Microsoft Word, Excel, PowerPoint; Inspiration; Print Shop; G Suite; SPSS; IDB Analyzer; and MAXQDA
- Knowledge of the Promethean brand of interactive displays

WORK EXPERIENCE

Administrative Experience

September 2010-May 2015 **Step by Step School** **New Delhi, India**

Coordinator of the Learning Center

- Supervise admission procedures for children with special needs (Mentally Challenged, Autism, Celebral Palsey, Learning Disabilities) in the age group of 3-8 years
- Train teachers in creating IEPs relevant to the students
- Counsel parents
- Review progress of each child and assist teachers in creating lessons as required
- Recruit and train teachers
- Provide early identification and assessment of children at risk

Teaching Experience

2006-2010 **Trinity School** **Atlanta, GA, USA**

Teacher and Learning Support Specialist

- Handle small group instruction for children with different learning abilities in math and reading
- Create differentiated lesson plans for the classroom
- Participate in administering various standardized tests as well as scoring and interpreting the results

Pallavan Preschool **New Delhi, India**

2004-2005 ***Coordinator***

- Plan the school and facility layout
- Design and adapt curriculum
- Recruit and train teachers and support staff
- Setup safety measures for children
- Supervise admission routines for students

2002-2004 ***Group Educator***

- Design and implement cognitive curriculum for children
- Conduct monthly assessments and reporting of children's progress
  - Areas of assessment included gross and fine motor skills, cognitive development and social skills

- Provide regular, formal and informal updates and interactions with parents

PROFESSIONAL SKILLS

- Assistant editor of *Forum for International Research in Education* (*FIRE*), a leading international peer reviewed publication in Comparative and International Education (2015)
- Attended a 2-day workshop on Attention-Deficit/Hyperactivity Disorder at the Trinity School, Atlanta, GA, USA (2008)
- Attended Reggio Emilia Approach training at Trinity school, Atlanta, GA, USA (2007)
- Training in the Visualizing and Verbalizing program by Lindamood-Bell, Atlanta, GA, USA (2007)
- Training in Circles of Confidence training to boost confidence in young children, University of Bristol, UK (2006)

RESEARCH INTERESTS

- Gender studies
- Teacher quality
- Early Interventions

ADHOC REVIEWER

- Educational Researcher 2014
- Educational Researcher 2015