HEAD OF THE CLASS:

EXPLORING THE LINK BETWEEN TEACHER QUALITY, INSTRUCTIONAL PRACTICE, AND STUDENT OUTCOMES IN INDONESIA, MALAYSIA, AND THE PHILIPPINES

A Thesis
submitted to the Faculty of the
Graduate School of Arts and Sciences
of Georgetown University
in partial fulfillment of the requirements for the
degree of
Master of Public Policy

By

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April 18, 2007
Washington, D.C.

To my mom and dad who always believed in me,
duo xie, ni.

To my advisor, Mike Puma, and all those without whom I could not have written this,
I have no words to express the magnitude of my appreciation.

With gratitude,
Kaily

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ABSTRACT

In the last several decades, Indonesia, Malaysia, the Philippines, and the entire Southeast Asian region in general, have made great strides in improving access to education for its student population by dramatically increasing spending and making education a national priority. However, this expansion in quantity and access has not translated into schooling quality, as evidenced by student achievement scores on the 2003 Trends in International Math and Science Study (TIMSS). With the notable exception of Malaysia, which ranked 10^{th} among the 46 countries surveyed, Indonesia and the Philippines placed 34^{th} and 41^{st}, respectively. As the most direct link in the delivery of education to students, teachers and their classroom practices have recently become the target of reform efforts to improve the quality of education in these three countries and around the world. This paper seeks to investigate the precise relationship between teacher quality, instructional practices, and student outcomes. More specifically, which of the teacher characteristics and classroom practices are more strongly correlated with higher test scores, and are there statistically significant differences in these results across countries? To answer these questions, a linear

regression model was run using the clustered robust standard errors method to account for potential autocorrelation problems created by the nested structure of the TIMSS data. The results of these regressions show that the impact of teachers on student achievement is largely unclear. Only three of the instructional practice variables—use of textbooks as the primary basis for lessons, use of computers during math lessons, and using higher-level math teaching skills—were statistically significant, although there was no significant difference in results between the three countries. These findings suggest that the keys to improving student outcomes is by increasing school resources and reforming instructional practices by incorporating these high level teaching skills into teacher training curriculums and professional development opportunities.

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I: INTRODUCTION

In the last several decades, Indonesia, Malaysia, the Philippines, and the entire Southeast Asian region in general, have made great strides in ensuring educational access and attainment for its schooling age population by dramatically increasing spending and making education a national priority. According to World Bank education statistics, in 2004, these three countries have nearly achieved universal primary enrollment—Indonesia, 94.3%, Malaysia, 93.2%, and the Philippines, 94.0%—and each has reached near gender parity in primary school enrollment (World Bank *EdStats,* 2004). Although there still remains a significant drop off in enrollment between primary and secondary school, more than half of all students in these three countries will go on to at least attend some secondary school (UNESCO, 2004).

By all counts, then, the traditional education indicators for these three nations have never looked better, and access to schooling is now less of an issue than ever before. However, as evidenced by student achievement scores on the most recent Trends in International Math and Science Study (TIMSS) conducted in 2003, schooling quantity does not always ensure schooling quality, and quality continues to remain very low throughout the region, with the notable exception of Malaysia. Of the 46 countries sampled in 2003, Malaysia ranked 10th overall in mathematics with an average scale score of 508 (compared to the international average of 466), placing it well above a number of the more developed countries, including the United States, Sweden, and Norway. Indonesia and the Philippines, on the other hand, had scores of

411 (34th) and 378 (41st), respectively. In science, Malaysia had a score of 510 (20th), slightly below the international average of 543, while Indonesia scored a 420 (36th) and the Philippines 377 (42nd) (National Center for Education Statistics, 2004). Moreover, the provision of a quality education, not just quantity of education, will become increasingly important as these countries begin to make the transition away from the low-skilled, labor-intensive industries that have traditionally been the cornerstone of their economic development in the response to tougher competition from China, India, and other developing countries (Sjöholm, 2002).

One of the potential explanations for these low achievement scores may lie with the quality of the current teacher workforce. Teachers, after all, are the most direct link in the delivery of education to students. Consequently, many education reform efforts in the Southeast Asian region and elsewhere, particularly in developing countries, are now focused on improving the quality of the instructors and their teaching pedagogy. Efforts include programs that offer incentives for teachers not to be absent from school, provide teachers with more training in their field of instruction, and efforts to change teachers' classroom practices. Because these reforms are a relatively recent development, though, new questions have and will undoubtedly continue to arise about which of these programs offer the biggest return on their educational investment, especially given that most developing countries have very limited resources to spend on trying out the latest trend in international education reform. Is it enough just to get teachers to the classroom day after day? Does it matter that teachers are trained in the subject they are teaching or that they have advanced degrees? Considering how difficult it is to change instructional practice, should countries with limited capabilities and funding even try?

As with most policy prescriptions, there is no "one-size-fits-all" answer to these kinds of "what works best?" questions. The impact of teacher quality and pedagogy, and consequently any changes or improvements in quality, on student achievement will likely vary from country to country. Understanding which unique teacher qualities and practices have the greatest impact on student outcomes then is a necessary precursor to making decisions about which educational reforms might be most effective. For instance, there is now increasing evidence that boys tend to learn better through active learning rather than passive lecturing and tend to dominate the classroom; in contrast, girls are more attuned to the emphasis on conformity that is the norm of many classrooms in most developing countries (Brint, 1998). Therefore, instructional techniques that promote the use of more active, hands-on activities may be correlated with higher test scores for boys than girls. Secondly, the high achievement scores observed in Malaysia may suggest differences in the effect of teacher quality and practices in that country (coupled with variations in cultures, types of students, etc.) compared to Indonesia or the Philippines that could account for this disparity in achievement, and by extension, lead to different policy recommendations for how to continue to improve their education.

To help address these questions, this paper uses TIMSS data, administered by the International Association for the Evaluation of Educational Achievement, to examine the relationship between student achievement in mathematics and indicators of teacher quality and instructional practices and to compare these relationships between Indonesia, Malaysia, and the Philippines. Based upon these results, recommendations will be made on where each government can best target its education spending to improve school quality, not just quantity, for all.

II: EDUCATION POLICY IN INDONESIA, MALAYSIA, AND THE PHILIPPINES

Indonesia

Compared to the rest of the developing world, as seen in the enrollment numbers noted above in the introduction, basic education is fairly widespread in Indonesia. By 1984, in fact, the government had implemented a six-year compulsory education program starting at the age of six, which proved to be highly successful, and in 1994, the government enacted the Basic Education Program, extending mandatory schooling to nine years. However, the 1997 economic crisis seriously derailed this effort to increase compulsory schooling through the junior secondary level, i.e. the end of ninth grade.

Even before the economic crisis, though, compared to the other countries in the region, Indonesia had one of the lowest rates of public expenditure on education as a percentage of GDP, less than two percent (Suryadarma et al., 2004). Recently, however, because of the economic downturn, Indonesia has had even less to spend since the government is starved for resources and must use about a third of its total revenues on servicing foreign debt. It is now estimated that it will cost the government close to 100 percent of GDP spread out over several years to reconstruct its financial sector, leaving few resources for educational improvements. By 2003, therefore, Indonesia was spending just 0.9 percent of its GDP on education or approximately nine percent of total government expenditure (UNESCO, 2004).

In 2001, after nearly four decades of centralized control by President Suharto, and partly prompted by the government's ongoing financial crisis, local communities were given substantially more discretion over public incomes and expenditures. As a result, districts have been able to have much greater control over its revenues, but have also assumed full responsibility for the provision of education to its citizens. This reform clearly gives localities more freedom to adapt their teaching and curriculum to local needs, but there are also a number of reasons to be concerned. In particular, this reform will undoubtedly benefit a few resource-rich provinces, but may leave many others behind to deal with diminishing incomes and increasing difficulties in meeting the new functions that have been delegated to them (Suryadarma et al., 2004). Coupled with the inability of the central government to help make up financial shortfalls, the challenges of decentralization will be even more pronounced in these poorer regions.

With less funding for education, classrooms will receive fewer supplies, dilapidated school buildings will not get fixed, and teachers will be underpaid or not paid at all. Teachers' salaries, which were already relatively low even before the 1997 economic crisis, have dropped even further in recent years. With annual mid-career salaries (including bonuses) of US$2,938 in primary and lower secondary education, Indonesian teachers' salaries are the lowest among the three selected countries, and starting salaries are even lower than this. Teaching salaries are also low when compared with average national incomes; teachers with 15 years' experience being paid the equivalent of just 1.1 times GDP per capita. As a result, the country has found it difficult to attract skilled educational professionals. Only 41 percent of all teachers have tertiary-level education, although the government has now mandated that all new teachers at the primary level must hold a tertiary-level qualification earned after a three or four-year program provided by a teacher training institute and including subject-matter instruction, pedagogical instruction, and six months of teaching practice ("Teachers for Tomorrow's Schools," 2001). In combination, all of these challenges are major obstacles in the government's effort to raise student achievement and likely reasons for the country's low TIMSS scores. Furthermore, with diminishing resources to tackle Indonesia's educational challenges, it will be more important than ever to have the research to inform its education investments in the most cost-effective and efficient interventions.

The Philippines

In contrast, the Philippines spends a little over three percent of its GDP on education (or 17 percent of its total government expenditure), which compares well with the northeast Asian countries. However, it also has the lowest GDP of the three nations, and so resources to deal with the growing population of school-age children are still limited. Nevertheless, according to the 2005 United Nations Development Program (UNDP) Education Index, which is calculated based on school enrollment and literacy rates, the Philippines has the highest index of the three selected countries, an 0.89 on a scale from 0 to 1, compared to 0.83 for Malaysia and 0.81 for Indonesia (UNDP Human Development Report, 2005).

The formal education system in the Philippines is divided into three levels: 1) basic education; 2) technical/vocational education; and 3) higher education. Basic education, the focus of this paper, which normally starts at age six, is divided into six years of primary schooling and four years of secondary schooling. Broad-based access to education is mandated under the constitution, and primary education is compulsory and provided free by the state. Secondary education, however, is voluntary. Also, as in Indonesia, the Philippines is also experimenting with the decentralization of some education functions from the central government to the local government units, including functions such as the construction and maintenance of school buildings, having greater access to financial resources, and the flexibility to supplement central government allocations. However, the central government continues to be in charge of the day-to-day operation of public schools (Behrman et al., 2002).

Although the Philippines has done relatively well according to the aforementioned enrollment figures and UNDP Education Index, a more in-depth look reveals a number of problems and shortcomings. As alluded to earlier, of the three countries, the educational outcomes for Philippine students in the TIMSS examination are the lowest and, in fact, are the lowest in the region. In addition, each year about a third of those who enter primary school never make it to the last grade in the cycle, and about a third never make it through secondary school (World Bank, 2005). High population growth rates, rising enrollments rates without concurrent investments in infrastructure and new teachers, and a tight fiscal situation have all potentially contributed to these poor outcomes. For example, between 1990 and 1999, the salaries of school teachers rose sharply which has constrained the ability of the government to hire new teachers and invest in the maintenance of school buildings and the purchase of much needed instructional inputs (Behrman et al., 2002). Teachers in the Philippines earn US$13,715, well above both Indonesia and Malaysia. Expressed as a percentage of GDP per capita, teachers' salaries are higher than even those in Organization for Economic Cooperation and Development (OECD) member countries. Additional compensation is also provided for extra teaching hours, out-of-school activities, and any other activities outside what is defined as normal duties. Such bonuses may increase the basic salary by up to 30 percent. With such an attractive salary incentive, the Philippines are able to attract highly educated individuals, and virtually all Philippine teachers have completed university-level education ("Teachers for Tomorrow's Schools," 2001). Therefore, it will be interesting to see the impact that Philippine teachers have on achievement, if at all, given the country's seeming contradiction in having highly qualified teachers and low student outcomes.

Malaysia

Finally, of the three selected countries, Malaysia, particularly given its level of economic development, has traditionally spent more on education than other countries in the region. In 2003, the public expenditure on education as a percentage of GDP was eight percent, which accounts for 28 percent of total government expenditures. Interestingly, however, even though primary enrollment rates are very high, it was not until 2002 that the Education Act of 1996 was amended to mandate six years of compulsory primary education for all children beginning at age six. Malaysia, like Indonesia and the Philippines, is also moving toward giving local districts, schools, and even teachers more control over the education decision-making process (Lee, 1999).

Malaysia's teachers are very well-paid and among the most qualified in the region. Almost all Malaysian teachers, in fact, have received a tertiary-level education. At the primary level, 97 percent of the existing teaching force hold a tertiary-type B qualification, and 96 percent of teachers in lower and upper secondary education are university-level graduates (Ministry of Education, 2004). In addition, the government recently launched a new effort to improve the quality of its teachers by putting stricter measures into place to ensure that only the qualified get teacher training, upgrading the qualifications needed to become primary school teachers from certificate to diploma level, providing more up-to-date training and higher salaries to existing teachers, and improving teacher education overall (Ministry of Education, 2004). The average salary for Malaysian primary teachers is US$11,803 (including bonuses), and their lower and upper secondary colleagues earn almost twice as much at a salary of US$21,568. Furthermore, there have also been measures aimed at enhancing teachers' status and motivation, including the revision of remuneration and promotion schemes, appropriate allowances and facilities for teachers teaching specific subjects and for those working in remote areas, and rewards for outstanding performance up to seven percent of their salary ("Teachers for Tomorrow's Schools," 2001).

Trends and Implications for Education Quality

Given these national differences, it is not unexpected to see such disparate test scores and levels of achievement between the highest performing country, Malaysia, and the two lowest performing, Indonesia and the Philippines. With such high levels of government spending on education, and a cadre of seemingly well-qualified teachers, it is not surprising that Malaysia has the highest student achievement results among the three selected countries, and it would also seem reasonable to hypothesize that teacher quality and their instructional practices have had a significant impact on Malaysian test scores. Indonesia, in contrast, which spends very little on education and has much lower teacher quality, has some of the lowest scores among all countries that participated in TIMSS. Further, if its relatively less-qualified teachers have any significantly positive impact at all on test scores, the effect will likely be weaker than in Malaysia or the Philippines. Finally, the Philippines provides a very interesting study in contrasts between low government spending on education and a very well-qualified population of teachers. In this case, one would naturally expect to see low scores, which may be explained by the lack of resources, student background characteristics, etc., and at the same time, one might also expect to see that teachers could have a potentially significant effect on test scores.

One common trend among all of these countries is the sharp drop off in enrollment at the secondary school level, which traditionally starts after the sixth grade. From near universal primary school enrollment rates and primary to secondary transition rates, as mentioned above, only slightly more than the majority of students complete secondary school. In Indonesia, according to the 2004 UNESCO Statistical Yearbook, 57 percent of girls and boys are in secondary school, and 67 percent of girls and 56 percent of boys are enrolled in secondary school in Philippines. In contrast, Malaysia's secondary school enrollment rates for girls and boys are slightly better at 69 percent and 70 percent, respectively.

Across the board, the school leavers are typically the poorest and weakest academically, who cite rising costs (e.g., higher school fees or a higher opportunity cost of not working) as one of the primary reasons for dropping out of school. For example, using data from the post-economic crisis Indonesia Family Life Surveys, RAND researchers Frankenberg, et al. (1999) found that higher levels of household expenditure are associated with a greater chance of enrollment and a lower chance of dropping out. Similarly, a recent World Bank study on early childhood education in Indonesia also found that, in general, the poorest children attend school later and do not complete the normal cycle of basic, junior secondary, and senior secondary education (World Bank, 2006). The same story appears to emerge in the Philippines as secondary school enrollment rates vary widely between the poorest and richest regions from just 22.7 percent in Mindanao to as high as 80.2 percent in the capital of Jakarta (Behrman et al., 2002).

In Malaysia, in addition to the trend of more socio-economically disadvantaged students dropping out of school after primary education, there is the added twist of ethnicity, particularly with the introduction of the National Education Policy, enacted in 1961, that clearly favored the Malay population over the two other major ethnic groups, the Indians and the Chinese. At independence in 1957, Malays had much lower educational attainment than either the Indians or the Chinese, but due in large part to these preferential policies, educational opportunities expanded rapidly for the Malays, allowing them to finally reach near parity in secondary school enrollment with their Chinese counterparts in the late 1970s (Pong, 1993). In fact, by the 1980s, Pong (1993) found that being Indian or Chinese actually had a negative impact on secondary school enrollment.

In light of this situation, and given that the TIMSS study collects data only for 8th graders in these three countries, it is likely that many of the poorest and least academically qualified students will have dropped out of school by the time these examinations were administered, leaving behind the most advantaged and talented Indonesian, Filipino, and Malaysian students. This may result in an upward bias due to selection in *all* of the reported achievement scores, which could influence how cross-country results are analyzed. However, with a higher percentage of students dropping out in Indonesia and the Philippines, one could hypothesize that there is an even stronger upward bias on test scores in these countries since more of the weaker students leave school before the year of TIMSS testing, whereas in Malaysia, there remains a larger pool of both weak and strong students, diluting the upward bias.

It is within this context and set of circumstances that Indonesia, Malaysia, and the Philippines are undertaking this new, emerging educational challenge: to improve the quality of education for its young people. With increasing competition from awakening tigers such as China and India, providing a quality education, not just raising the quantity of education, will be a key to future economic growth and prosperity.

III: LITERATURE REVIEW

Teacher Characteristics

In both the developed and developing world, the extent of the literature on the impact of teacher quality on student achievement, as measured by test scores, has revealed mixed results. Some studies have suggested that teachers have no impact. Others, however, conclude that teachers have a very strong influence on test scores, although very few find that teachers exert a negative influence on student achievement, which is likely due to publication bias as researchers are more unwilling to publish perverse findings. Certain teacher qualities, such as training, specifically content-area training, salary, and to a lesser extent, educational level and teacher absenteeism, also seem to matter more than other factors, i.e. teacher experience.

Meta-Analyses of Teacher Characteristics

In a meta-analysis of 60 empirical studies conducted in developing countries on school factors and student achievement, Fuller (1983) found the majority of studies concluded that some teacher characteristics matter, particularly years of tertiary education and in-service teacher training. However, some of the expected drivers of achievement, i.e. teacher's length of experience, low absenteeism, and social class background, were not found by most studies to have a positive influence on student outcomes.

The overall pattern of relationships in Saha's (1983) study of the 230 independent empirical findings in 38 studies on school inputs closely echoes Fuller's conclusions. Of the 41 separate findings, 21, or about half, showed clear positive effects of teacher credentials and certification—a probable proxy for training—while 18 showed no relationship at all. An even division between positive and negative or insignificant effects was also found in the relationship between teacher experience and achievement, suggesting a very weak overall impact on test scores. On the other hand, teacher educational attainment, in contrast to Fuller's conclusion, was found to have a positive effect only in four of the 11 findings. In addition, male teachers were also found to be more successful in teaching science, while females were found to do better in language teaching and related subjects.

One significant drawback to both the Fuller and Saha study, though, is that both are very dated, drawing on studies conducted during the sixties and seventies. In a more recent survey of close to 100 quantitative studies of the effectiveness of school resources in developing countries, Hanushek (1995) found that a slight majority, 35 of the 63, of studies on teacher's education had statistically significant positive effects on achievement, which aligns with Fuller's findings, while 28 of 63 studies had effects that were statistically negative or insignificant. Twenty-eight of the 46 studies conducted on teacher's experience also found no significant effect of this characteristic on education, compared to just 16 that concluded teacher's experience had a statistically positive effect. Teacher salary, too, only had a statistically positive impact on student outcomes in four of the 13 studies, while two showed negative effects.

The studies Hanushek review primarily examine the statistical correlation between school inputs, like teacher quality, and test scores from which he concludes that adding school resources, such as hiring more experienced teachers or increasing their salaries, do not seem to improve student achievement. Kremer (1995), however, critiques this approach by noting that the exclusion of key explanatory variables could lead to spurious correlations, i.e., some of the observed positive results may not be accurate, and some insignificant correlations could, in fact, be significant. Additionally, Kremer notes that Hanushek weights each study equally to draw his conclusions, despite differences among the studies in the number of observations, procedures, and controls, etc. Given the similarities in methodology with Hanushek's study and the other two meta-analyses reviewed above, these critiques likely apply to the Saha and Fuller analyses as well, making all of these three studies relatively weak evidence of the effect of teachers and classroom practice on student outcomes.

In a statistically stronger paper, using more sophisticated procedures for aggregating the information in different studies, Hedges, Laine, and Greenwald (1994, as cited in Kremer, 1995), in contrast to Hanushek, found a positive relationship between spending on education and output. In addition, according to Kremer's (1995) calculations, the chance of obtaining an insignificant result is likely very large, even if the true correlation is positive, and so there seems to be evidence to conclude that *both* teacher education *and* experience might have positive effects.

International Studies on Teacher Characteristics

Corroborating the mixed results in the meta-analyses of literature on teacher quality and student achievement, Mullens, Murnance, and Willett (1996) use data from a two-stage stratified random sample of over 1,000 students during the 1990-1991 school year in Belize. They found that none of the indicators of teaching effectiveness—teacher training, secondary education attainment, teacher competency in math—had a statistically significant relationship with student learning of *basic* concepts. However, in learning more advanced concepts, students taught by teachers that had demonstrated strong mathematical ability during their own schooling learned the concepts more rapidly and had a higher gain in test scores. High school completion, when a teacher's mathematical competency is not known, was also shown to have a positive relationship to gains in scores. High school graduates are obviously more likely to have developed higher competencies during their high school years than teachers who did not graduate, so secondary education completion is a good secondary indicator of subject matter competency. Teacher training, however, in contrast to the results of earlier reviewed studies, did not appear to matter. One possible explanation for this difference offered by the authors is that the effect of teacher training may be collinear with other control variables, such as years of experience and "urban-ness," thus diluting its unique contribution. The nature of training in Belize may also vary from other countries, which may also help to explain why findings differ from other studies.

These findings, though, were strikingly similar to those of Harbinson and Hanushek (1992, as cited in Mullens, et al., 1996), who also found that teacher subject matter competence was the best predictor of student mathematical achievement in rural northeast Brazil, while years of teaching experience and participation in training programs were not strong predictors of students' achievement. Likewise, in their study of 400 rural primary schools in Thailand, Raudenbush, et al. (1993) concluded that there was little empirical evidence to indicate that a teacher's experience in in-service training courses predicted improved instructional quality or student achievement.

In a study of the correlation between school quality and student achievement in a cross-section of 58 developed and developing country that participated in international tests in mathematics, science, and reading, Barro and Lee (2000) also found empirical evidence that the average educational level of adults aged 25 and above had a significantly positive effect on test scores. The authors interpreted this variable as a proxy of parents' education, but clearly it also captured the education of teachers. The only other teacher variable modeled, the log of the average salary of primary school teachers, had a positive, though less statistically significant, relation with test scores.

Finally, after administering tests and extensive surveys to 2,000 students age 9-12 in the rural areas of Gansu Province, Park and Hannum (2001) cautiously inferred from the resulting data that much of the variation in the test scores of Chinese students, about a fourth, was likely due to teacher differences. For math and language scores, higher teacher quality rankings, as calculated using teacher evaluations performed by the central government, substantially increased test scores, although in math, the quality effects diminished over time as teachers continued to teach students for multiple years. Other teacher characteristics also mattered, especially for math scores, including their education level, wages, status as government employee, and whether the teacher was a native villager. Unlike many of the studies reviewed above, however, Park and Hannum found that teacher experience did have a positive effect on test scores.

Classroom Instructional Practices

In contrast to studies on teacher background characteristics, there has been much less work done on the effects of classroom instructional and organizational practices on student achievement. In Fuller's 1983 meta-analysis, just 31 studies, compared with 116 on teacher quality, examined teaching practices and classroom organization. In general, the length of the instructional program, the frequency of homework, higher teacher expectations, and more time spent on class preparation were all positively correlated with better student achievement.

Saha (1983) also found that teacher expectation of students and certain teaching methods such as programmed instruction, microteaching, and the use of the television were found to have a positive relationship to student achievement. However, the link between achievement and teacher behavior, as defined by lesson preparation and assignment of homework, was not as clear as in Fuller's meta-analysis. Ten found positive effects, while 10 also found an insignificant or negative correlation. Lastly, using the pre- and post-test scores of 238 students in three types of schools in Malawi to investigate the impact on test scores of allowing students to practice new concepts, Miske and Dowd (1998, as cited in UNICEF, 2000) found that in schools with greater learning gains, teachers gave students pupils more opportunities to practice new material using more teaching aids, and teachers checked pupil learning more often.

Studies on Teacher Characteristics and Classroom Instructional Practices in Indonesia, the Philippines, and Malaysia

Studies in the three selected countries investigating the link between teachers, instructional practices, and achievement have been limited, but results do seem to suggest that several teacher characteristics are correlated with performance. In an Indonesian study on the determinants of student performance on math and diction tests, given that the quadratic teacher experience term in the math regressions was positive and statistically significant, Suryadama, et al. (2004) concluded that teacher experience may have an increasing marginal return over at least some range. Teacher absence was also found to be significantly and negatively correlated with student performance on the math test, but had an insignificant effect on the diction test. The authors suggest that this points to a difference in the role of the teacher in the development of mathematical versus language skills. For instance, while diction may be learned outside the home, math must be taught in schools with trained instructors. Interestingly, Suryadama, et al. also found that the proportion of female teachers in a school has a negative and significant correlation with the math performance of males.

Finally, using data collected in the 1990-1991 Household and School Matching Survey to estimate a model on student achievement, Tan, et al. (1997) found that teachers' subject knowledge exerts a significant influence in Filipino, but not in math.

Like earlier studies on teacher quality in developing countries, teaching experience was also found to have an insignificant effect on student achievement. In terms of instructional practices, students of teachers in schools that favored experimentation were also found to perform better on tests.

An evaluation of four randomized school intervention experiments in the Philippines found that schools that received multi-level learning materials that allow teachers to tailor instruction to students of different ability levels had a statistically significant decline in dropout rates, and after controlling for selection bias, this was the only one of the four interventions that had a measurable effect on dropout rates. This intervention was also found to have a strong impact on student achievement in Filipino and English, particularly when coupled with a program that encourages parent-teacher partnerships (Tan, Lane, and Lassibille, 1999).

Bacolod and King (2003) applied quantile regressions to Philippine survey data to estimate the differential impact of various schooling inputs on students distributed across the range of English and math achievement levels. They found that certain inputs have different impacts on students depending upon where they fall along the achievement distribution. For example, teacher experience had a greater positive impact at the top end of the conditional distribution, but not for lower achieving students, while student-teacher ratios had a larger impact for the average student and for the high achievers in math. After using controls for students that attend schools outside their district, students who do not attend the nearest school, and students who transferred schools, their findings suggest that more experienced teachers raise English and math outcomes at a diminishing rate for the average and above-average students.

Using TIMSS data from 1999, researchers from the University of Malaya studied the effects of school inputs, such as pupil teacher ratio, teaching experience, and instructional hours, among others, on educational outputs as measured by math and science test scores. Results show that the pupil-teacher ratio was found to be positively correlated with achievement, and instructional hours can be used to offset the low level of out-of-school study time. Like earlier studies on teacher quality in developing countries, teacher experience was found to have no additional explanatory power and was subsequently dropped from the model (Isamil and Cheng, 2005).

What clearly emerges from the literature on the impact of teacher quality and their instructional practices on student achievement is the lack of clear evidence. While some studies have suggested that teachers have no impact, other researchers have concluded that teachers exert a very strong influence on student test scores. In some studies, certain teacher characteristics, such as years of experience, teacher training, etc., were found to increase student achievement, while others have found these same characteristics and practices to be insignificant in increasing test scores. Subject matter competence, however, was more consistently shown to be associated with higher student test scores across a number of different studies. Finally, even less conclusive and consistent evidence exists on the effects of classroom practices on student achievement.

IV: RESEARCH METHODOLOGY

From the review above, it seems clear that specific research on the link between the teacher, and particularly their classroom practices, and student achievement has so far been very limited in Southeast Asia and what research does exist on this region and elsewhere appears to be fairly inconclusive. This paper attempts to fill in this research gap by looking at three selected countries in the Southeast Asian region—Indonesia, Malaysia, and the Philippines—and the correlation between TIMSS test scores, teacher quality, and instructional practices, and possible variations across the three education systems.

Specifically, this paper seeks to address two research questions: 1) What is the relationship between teacher quality, classroom practices, and student outcomes, and do some relationships matter more than others?; and 2) Is there a statistically significant difference in the relationship between instructional variables and student's math achievement among the three countries?. These analyses will shed more light on the specific teacher characteristics and instructional practices, if any, that have had the greatest impact on student outcomes on the 2003 TIMSS math tests, paving the way for making improvements in the quality of education in each country.

Data Source(s)

Every four years, the Trends in International Math and Science Study (TIMSS) administered by the International Association for the Evaluation of Educational Achievement, collects educational achievement data in science and math, and links these student-level data to information on the backgrounds of their teachers, classroom instructional practices, and school characteristics. Of the 46 countries currently included in TIMSS, this analysis will use student, teacher, and school data from three Southeast Asian countries—Indonesia, Malaysia, and the Philippines.

The data come from the 2003 TIMSS and consist of the following sample sizes: Indonesia, 5,762 students, 155 teachers, and 150 schools; Malaysia, 5,314 students, 150 teachers, and 150 schools; and the Philippines, 6,917 students, 155 teachers, and 137 schools. Each sampling of students was nationally representative, and by weighting the sample in the analysis, allows the analysis results to be extrapolated to all the eighth graders in each nation as a whole.

Analysis methods

To investigate the relationship between teachers and instructional practices and student test scores in Southeast Asia, an ordinary least squares (OLS) regression analysis of the available TIMSS data was conducted on the pooled data from all three countries, incorporating the respective country-specific TIMSS student sampling weights. The primary outcome variable was student math achievement scores, and the independent variables were teacher characteristics, indicators of teacher quality, and variables on classroom instructional practices. To control for variations in student and parental backgrounds and school characteristics that may affect student achievement, these background variables were also included in the statistical analyses.

The following is the general model specification:

$$\textit{Test Scores} = \beta_0 + \beta_1(\textit{Teacher Quality}) + \beta_2(\textit{Instructional Practice}) + \beta_3(\textit{Teacher Background}) + \beta_4(\textit{Student Background}) + \beta_5(\textit{Parent Background}) + \beta_6(\textit{School}) + \varepsilon;$$

As educational and economic literature has noted, though, the simple ordinary least squares formula for standard errors is incorrect in the presence of clustering of students within classrooms and classrooms within schools. This clustering could potentially lead to problems with the autocorrelation of error terms, and as a result, in most cases, the standard errors will be underestimated, leading to unwarranted findings of statistical significance (Somers et al., 2004). The coefficient estimates, however, will remain unbiased. Consequently, "clustered robust standard errors" were calculated in Stata to account for the clustering of students in schools.

For a table of the descriptive statistics for the variables on teacher quality and instructional practice, as well as on the control variables on student, parent, teacher, and school background characteristics for student, please refer to *Appendix A: Descriptive Statistics Table*.

Finally, the analyses on the differences in the relationship between teachers, their instructional practices, and student outcomes was run using the five plausible values for math test scores in each of the three countries. The use of plausible values comes from the Item Response Theory, which recognizes the fact there is uncertainty around estimated test scores, and so for each student, five possible values from their distribution of math scores is provided in the TIMSS data. As a result, the regression model was run five times, and the coefficient and standard error parameter estimates were averaged to get a single value for each independent variable with the t-statistics and p-values computed from these averaged estimates. Finally, the differences between each country in the averaged coefficients were tested for statistical significance by including interaction terms. For example, looking at the variable on teachers using high-level math-teaching skills, by including an interaction term with the country dummy variable, i.e. IDNA*TCHHGHLVLM, the differential impact on test scores of being a student in Indonesia taught by a teacher using these higher-level skills versus in Malaysia or the Philippines was determined.

V: RESULTS

The results obtained from running an OLS regression analysis on the pooled TIMSS data using four different model specifications are presented in Table 1. In Column (1), the general model specified in the analysis methods section above was used. From this result, three instructional practice variables were determined to be statistically significant at the 90 percent confidence level or higher. In the subsequent second, third, and fourth regressions, these three variables were interacted with the country dummy variables for Indonesia and Malaysia to obtain the last three sets of results in columns (2), (3), and (4).

For regression results with non-clustered robust standard errors, please see *Appendix B: Results with Non-Clustered Robust Standard Errors*. As expected, the standard errors calculated in these sets of regressions were much lower than in the previous analysis using the corrected standard errors, resulting in a greater number of coefficients that were found to be statistically significant at the 90 percent confidence level or higher.

Table 1: Regression Results

Variables	Description	(1) General Model	(2) Model (1), Including Interaction With Use of Textbooks Variable	(3) Model (1), Including Interaction with Use of High-Level Teaching Skills Variable	(4) Model (1), Including Interaction with Use of Computers During Math Lessons Variable
Country Variables					
IDNA	Indonesia	35.350*** (8.049)	30.008** (11.855)	28.214 (31.438)	34.260*** (9.497)
MYSA	Malaysia	131.833*** (10.603)	136.433*** (12.131)	151.828*** (32.758)	131.509*** (10.214)
Student Background Variables					
BSDAGE	Student's Age	-14.699*** (3.233)	-14.670*** (1.397)	-14.683*** (-1.381)	-14.709*** (1.395)
FEMALE	Student's Gender	-1.049 (1.472)	-0.961 (1.742)	-1.064 (1.733)	-1.043 (1.738)
FREQBSBGOLAN	Language of Test Frequently Spoken at Home	-19.482*** (4.666)	-19.376*** (4.830)	-19.404*** (4.828)	-19.594*** (4.812)
STUDEDEXPEC	Student's Educational Expectation	33.750*** (4.559)	33.806*** (2.978)	33.793*** (2.949)	33.674*** (2.938)
BSBGHFSG_MISS		6.923** (2.859)	7.006** (3.117)	6.904** (3.063)	6.915** (3.095)
Parental Background Variables					
MOTHERPOSTSEC	Mother's Education: Post-Secondary	21.209*** (3.915)	21.35*** (3.208)	21.244*** (3.182)	21.286*** (3.210)
MOTHERPOSTSEC_MISS		-9.474*** (2.804)	-9.410*** (2.850)	9.452*** (2.845)	-9.447*** (2.825)
Education Attitude Variables					
HIGHMSELFCON	High Self-	19.401***	19.431***	19.448***	19.432***

	Confidence in Learning Math	(3.459)	(2.261)	(2.256)	(2.266)
HIGHMVAL	Students' Highly Value Math	6.770*** (2.634)	6.831** (2.488)	6.787*** (2.502)	6.905*** (2.504)
Teacher Background Variables					
TCHFEMALE	Gender of Teacher	5.501 (5.490)	5.906 (6.689)	5.460 (6.763)	5.643 (6.700)
TCHEXPER	Years of Teaching	0.543 (0.617)	0.538 (0.472)	0.540 (0.47)	0.547 (0.470)
BTBTAUT_MISS		4.747 (11.876)	4.929 (15.583)	4.592 (15.037)	4.648 (14.935)
MATHMAJOR	Math Major	1.958 (5.133)	2.046 (6.318)	2.068 (6.338)	2.185 (6.258)
BTBMPSMA_MISS		17.156 (12.475)	17.133 (14.947)	17.280 (15.110)	16.942 (15.328)
TCHINTERACT	Frequency of Teacher Interaction	-3.997 (4.859)	-4.477 (5.944)	-3.705 (6.007)	-3.809 (5.938)
PROFDEV	Professional Development in Mathematics Content	9.879 (6.967)	9.620 (8.425)	9.703 (8.424)	9.660 (8.523)
POSMBEL	Agreement with Positive Beliefs About Math	4.119 (7.322)	3.753 (9.064)	4.309 (9.010)	4.524 (9.053)
Instructional Practice Variables					
BTBMSTUD	Class Size	0.004 (0.330)	0.033 (0.394)	-0.007 (0.394)	-.003 (0.391)
BTBTEXTBK	Use of Textbooks as Primary Basis for Lessons	21.580*** (5.957)	16.622 (10.489)	21.529*** (6.603)	21.511*** (6.634)

BTBMTXBU_MISS		17.466* (10.182)	14.559 (12.767)	17.066 (12.121)	17.114 (12.345)
IDNA*BTBMTXBU			9.46 (14.053)		
MYSA*BTBMTXBU			-6.342 (13.117)		
TCHHGHLVLM	Frequency Teachers Use High Level Math-Teaching Skills	11.119** (4.648)	11.342** (5.328)	10.302 (9.881)	10.8999** (5.329)
IDNA* TCHHGHLVLM				2.881 (12.258)	
MYSA* TCHHGHLVLM				-8.952 (13.437)	
BTBMCOMP	Students Use Computers During Math Lessons	39.438*** (10.095)	39.335*** (11.613)	39.122*** (11.722)	33.441* (20.120)
BTBMCOMA_MISS		9.617 (11.854)	9.365 (14.845)	9.665 (14.647)	9.843 (14.569)
IDNA* BTBMCOMP					9.967 (25.821)
MYSA* BTBMCOMP					1.223 (25.490)
School Background Variables					
BCBGASTD	Student Absenteeism	-12.275** (6.105)	-11.779 (7.234)	-11.649 (7.226)	-12.566* (7.159)
BCBGSBED	% of Students Come from Economically Disadvantaged Homes	-20.057*** (5.733)	-19.803*** (6.311)	-19.998*** (6.424)	-20.239*** (6.434)
BCBMGAMC	Students Grouped by Ability	13.433** (6.199)	13.302* (7.339)	13.705* (7.291)	13.463* (7.205)
BCBMRRTM	Math Teacher Incentives	3.710 (6.405)	3.554 (-7.906)	3.675 (7.911)	3.486 (7.881)
Observations		16657	16657	16657	16657
R-Squared		0.326	0.327	0.326	0.326

Clustered, robust weighted standard errors in ( ).

*** indicates significance at the 99% confidence level.
** indicates significance at the 95% confidence level.
* indicates significance at the 90% confidence level.

Student, Parental, and School Background

Generally, the majority of the student, parental, and school background variables, serving as controls for the inherent differences among the test takers, was found to be very statistically significant and had the expected impact on the students' test scores. However, with the data on mother's post-secondary education and student's educational expectation, there was a large amount of missing observations, which were found to be systematically different than those in their respective baseline groups, i.e. students who reported their mother's education as not having finished post-secondary education or students who do not expect to complete tertiary education or higher. These observations, therefore, if there had been data, could potentially affect the results obtained on the impact of mother's post-secondary education or student educational expectations on test scores.

More significantly, though, and contrary to expectations, the gender of the student was found to have no statistically significant effect on the math test scores, and students from homes that frequently spoke the language of the test at home actually did worse on the exam than one would have predicted. This unusual outcome may be due in part to the large immigrant populations in Indonesia and Malaysia from China and India. Traditionally, these student populations, who would more likely speak their

Chinese and Indian-dialect mother tongues at home, have done better on math exams than the native Malay or Indonesian students, which would suggest that frequently speaking the language that the test is administered in may not be a good predictor of potential success on the exam for these particular countries.

Teacher Background and Instructional Practices

More interestingly, when looking at the results of teacher characteristics and instructional practices and their impact on student achievement, the trend that quite clearly emerges is the lack of statistical significance for most of the coefficients. This strongly suggests that most of these teacher background characteristics and a teacher's classroom and instructional practices have an uncertain, and possibly limited, impact on achievement, which seems to continue the trend revealed in previous studies.
Only three variables of the ten teacher background and instructional practice variables were shown to have any statistically significant impact on test scores across all three countries: 1) teachers teaching high level math; 2) the use of computers during math lessons; and 3) the use of textbooks as the primary basis for lessons.

Holding all other variables constant, students that use computers during math lessons had test scores that averaged 39.44 points higher than students that did not, and students in classes that used textbooks as the primary basis for lessons had scores that were 21.58 points higher on average. Standardizing the effect size by standard deviations, calculated by dividing the coefficient by the standard deviation of the test scores, the effect of using computers on test scores was 0.40 standard deviations, while the impact of textbooks on those students in classes where they were the primary basis for lessons was 0.27 standard deviations. By educational standards, these are very large effects.

The data on the use of textbooks as the primary basis for lessons, though, should be considered very carefully in the analysis as there was a large amount of missing observations that were found to be systematically different than those in the baseline, i.e. students taught by teachers who *did not* use textbooks as the primary basis for lessons. In light of this, if the missing data had been available, these observations could potentially affect the results on the impact of textbooks on test scores.

Finally, holding all other variables constant, students taught by instructors who utilized higher level math-teaching methods, such as having students tackle problems for which there is no immediately obvious method of solution, work together in small groups, explain their answers, etc., scored 11.12 points higher on the exam than students taught by teachers who did not employ these methods. In terms of the effect size, this variable had the smallest effect on student test scores, just 0.11 standard deviations.

However, when looking at whether there are any differences across countries in regards to the impact of these three variables on student outcomes, no statistically significant difference was found between their effects on students in Indonesia, Malaysia, and the Philippines. This suggests that similar policy recommendations would be made across all three education systems to increase student achievement.

VI: POLICY RECOMMENDATIONS AND CONCLUSION

At the dawn of the twenty-first century, more and more countries around the world are turning to making improvements to their education systems to ensure that their country remains competitive in this increasingly globalized world economy. Indonesia, Malaysia, and the Philippines are no different.

In the last several decades, all three countries have made great strides in improving access to education for their student population by dramatically increasing spending and making education a national priority. However, this expansion in access has not always meant a concurrent increase in schooling quality. With the notable exception of Malaysia, which ranked quite well even in relation to the developed world, Indonesia and the Phillippines ranked near the bottom of the 46 developed and developing countries surveyed.

As the most direct link in the delivery of education of students, teachers and their classroom practices have become the latest target of reform efforts to improve the quality of education in these three countries and around the world. Reforms span the spectrum from offering incentives for teachers not to be absent from school to improving the national teacher training curriculum to changing teaching practices.

Given the relatively recent nature of these reforms and the funding constraints faced by most developing countries in trying out the latest trends, questions have arisen about which of these programs are the most effective and offer the biggest return on their educational investment. Previous research has shown that the impact of teacher quality on student achievement is quite mixed with some studies suggesting that teachers have no impact, while others conclude that teachers have a very strong influence on test scores.

Using TIMSS data on math test scores from 2003, this paper attempted to clarify this relationship in Indonesia, Malaysia and the Philippines by examining the association between student achievement, indicators of teacher quality, and instructional practices in these three countries. Like the previous literature, the results show that teachers have an unclear impact on student outcomes with all of the variables on indicators of teacher quality and most of the instructional practice variables showing no statistically significant effect on student test scores. Only three of the instructional practice variables—use of textbooks as the primary basis for lessons, use of computers during math lessons, and using higher-level math teaching skills—were statistically significant. However, these results were not statistically significantly different across the three countries, suggesting that similar policy changes could be made to help improve all three education systems.

In light of these results, the answer to the "what works best?" question posed earlier in this paper to raise student achievement outcomes seems to be: 1) to increase the use of computers in the classrooms during math instruction; 2) to increase the use textbooks as the basis for instruction; and 3) to change instructional practices to include more higher level teaching skills, such as having students work in small groups, explain problems, etc. Therefore, the two clearest policy recommendations to emerge from this research are:

- More government funding for education directly aimed at increasing the resource level of the schools, i.e. for the purchase of more textbooks, computers, etc, and at training teachers to effectively use these tools in their classrooms.

- Incorporate more of the high level teaching skills identified by the TIMSS test into teacher training curriculums and professional development programs. These teaching skills include: a) practice adding, subtracting, multiplying, and dividing without using a calculator; b) work on problems for which there is no immediately obvious method of solution; c) interpret data in tables, charts, or graphs; d) write equations and functions to represent relationships; e) work together in small groups; f) relate what students are learning in mathematics to their daily lives; g) have students explain their answers; and finally, h) have students decide on their own procedures for solving complex problems.

However, given the serious funding constraints faced by most of these countries, particularly Indonesia and the Philippines, the policy priority should be to allocate more funding to increase the use of textbooks in the classroom. Although the effect size is smaller than that of the impact of computers on test scores, textbooks are cheaper so it is likely that the government will get a higher, faster return on their investment than buying more computers or reforming how teachers teach. Expanding a country's educational technology infrastructure requires a huge financial investment, and reforming how teachers teach likely will be an even more complicated, more expensive, and longer-term process involving many actors, i.e. teacher training institutions, schools, and the teachers themselves, among others, as well as much trial-and-error to see what works and what does not.

Whatever the policy path Indonesia, Malaysia, and the Philippines chooses, whether improving the quality of the teaching workforce or increasing educational resources, with growing competition from awakening tigers such as China and India, what is for certain is that all three countries will continue to face significant and rising challenges as they seek to become bigger players on the world economic and political stage. Finally, and most importantly, what is also certain is that providing a quality education will be one of the most important keys to achieving this vital goal.

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APPENDIX A: DESCRIPTIVE STATISTICS TABLES

Indonesia—Student Scores and Weights

Scoring Variable	Description	N (msng)		Mean	Min	Max	Std. Dev.
BSMMAT01	1st Plausible Value-Math	5762		419.062	54.087	743.315	88.844
BSMMAT02	2nd Plausible Value-Math	5762		418.444	113.778	711.789	89.316
BSMMAT03	3rd Plausible Value-Math	5762		417.676	119.801	709.031	89.552
BSMMAT04	4th Plausible Value-Math	5762		418.911	95.624	711.972	88.834
BSMMAT05	5th Plausible Value-Math	5762		419.214	108.344	702.507	88.0455
Weight Variable	**Description**	**N (msng)**		**Mean**	**Min**	**Max**	**Std. Dev.**
TOTWGT	Total Student Weight	5762		402.294	144.088	1214.29	136.757

Indonesia—Student/Parental Background Descriptive Statistics

Student Bkgrd Variable Name	Descrip.	N (msng)	Freq.	Mean	Min	Max	Std. Dev.
BSDAGE	Student's Age	5760 (2)		14.426	11.083	18.333	0.792
BSBGSEX	Student's Gender	5755 (7)	Male =2914 [50.57] Female =2841 [49.31]				
FREQBSBGOLAN	Language of Test Frequently Spoken at Home	5739 (23)	Yes = 1857 [32.23] No = 3882 [67.77]				
BSBGHFSG	Student's Educational Expectation	5668 (94)	Will Not Complete Tertiary Ed.=1304				

			[22.63] Will Complete Tertiary Ed. or Higher=3169 [55.00]				
Parental Bkgd Variable Name	**Descrip.**	**N (msng)**	**Freq.**	**Mean**	**Min**	**Max**	**Std. Dev.**
MOTHERPOSTSEC	Mother Completed Post-Secondary Education	4728 (1034)	Yes = 432 [7.50] No = 4296 [92.50]				
Student Education Variable Name	**Descrip.**	**N (msng)**	**Freq.**	**Mean**	**Min**	**Max**	**Std. Dev.**
HIGHMSELFCON	High Self-Confidence in Learning Math	5662 (100)	Yes =1479 [26.12] No = 4183 [73.88]				
HIGHMVAL	Students' Highly Value Math	5690 (72)	Yes = 4037 [70.95] No = 1653 [29.05]				

Indonesia Teacher Background, Teacher Quality, and Instructional Practice Descriptive Statistics

Teacher Bkgd Variable Name	Description	N (msng)	Freq.	Mean	Min	Max	Std. Dev.
TCHFEMALE	Gender of Teacher	153 (2)	Male=79 [51.63] Female=74 [48.37]				
BTBGTAUT	Years of Teaching	146 (9)		13.719	1	29	6.923
BTBMPSMA	Math Major	146 (9)	Yes=86 [55.48] No=60 [38.71]				
TCHINTERACT	Frequency of Teacher Interaction	152 (3)		2.382	1	4	0.604
PROFDEV	Professional Development in Mathematics Content	151 (4)	Yes=84 [54.19] No=67 [43.23]				
POSMBEL	Agreement with Positive Beliefs About Math 1=Disagree a Lot to 4=Agree a Lot	152 (3)		3.330	2.4	4	0.356
Instructional Practice Variable Name	**Description**	**N (msng)**	**Freq.**	**Mean**	**Min**	**Max**	**Std. Dev.**
BTBMSTUD	Class Size	150 (5)		38.880	5	52	7.031
BTBMTXBU	Use of Txtbk as Primary Basis for Lessons	146 (9)	Primary Source=96 [65.75] Supplementary Source=50 [34.25]				
TCHHGHLVLM	Teachers Teach High Level Math (1=Never; 4=Every or Almost Every Lesson)	151 (4)		2.487	1	4	0.566
BTBMCOMA	Students Use	138	Yes=16				

	Computers During Math Lessons	(17)	[10.32] No=122 [78.71]					

<u>Indonesia School Characteristics Descriptive Statistics</u>

School Characteristics Variable Name	Description	N (msng)	Freq.	Mean	Min	Max	Std. Dev.
BCBGASTD	Student Absenteeism	150	Less than 5%=131 [87.33] 5% or More=19 (12.67)				
BCBGSBED	% of Students Come from Economically Disadvantaged Homes	150	50% or Less=70 [46.67] More than 50%=80 [53.33]				
BCBMGAMC	Students Grouped by Ability	150	Yes=25 [16.67] No=125 [83.33]				
BCBMRRTM	Math Teacher Incentives	149 (1)	Yes=48 [32] No=101 [67.33]				

Malaysia—Student Scores and Weights

Scoring Variable	Description	N (msng)		Mean	Min	Max	Std. Dev.
BSMMAT01	1st Plausible Value-Math	5314		507.872	268.904	749.848	74.055
BSMMAT02	2nd Plausible Value-Math	5314		508.619	266.649	756.553	75.948
BSMMAT03	3rd Plausible Value-Math	5314		509.302	257.237	769.848	75.499
BSMMAT04	4th Plausible Value-Math	5314		508.501	257.304	733.956	75.238
BSMMAT05	5th Plausible Value-Math	5314		508.710	268.263	750.894	74.395
Weight Variable	**Description**	**N (msng)**		**Mean**	**Min**	**Max**	**Std. Dev.**
TOTWGT	Total Student Weight	5314		77.956	27.169	285.439	23.827

Malaysia—Student/Parental Background Descriptive Statistics

Student Bkgrd Variable Name	Descrip.	N (msng)	Freq.	Mean	Min	Max	Std. Dev.
BSDAGE	Student's Age	5314		14.337	12.833	15.750	0.372
BSBGSEX	Student's Gender	5314	Male =3071 [57.79] Female =2243 [42.21]				
FREQBSBGOLAN	Language of Test Frequently Spoken at Home	5311 (3)	Yes =3464 [65.19] No =1847 [34.81]				
BSBGHFSG	Student's Educational Expectation	4700 (614)	1) Will Not Complete Tertiary Ed.=1338				

			[25.18] 2) Will Complete Tertiary Ed. or Higher =3362 [63.27]				
Parental Bkgd Variable Name	**Descrip.**	**N (msng)**	**Freq.**	**Mean**	**Min**	**Max**	**Std. Dev.**
MOTHERPOSTSEC	Mother Completed Post-Secondary Education	4395 (919)	Yes=885 [16.65] No = 3510 [83.35]				
Student Education Variable Name	**Descrip.**	**N (msng)**	**Freq.**	**Mean**	**Min**	**Max**	**Std. Dev.**
HIGHMSELFCON	High Self-Confidence in Learning Math	5293 (21)	Yes = 2037 [38.48] No = 3256 [61.52]				
HIGHMVAL	Student Highly Value Math	5292 (22)	Yes = 4122 [77.89] No = 1170 [22.11]				

Malaysia—Teacher Background, Teacher Quality, and Instructional Practice Descriptive Statistics

Teacher Bkgd Variable Name	**Description**	**N (msng)**	**Freq.**	**Mean**	**Min**	**Max**	**Std. Dev.**
TCHFEMALE	Gender of Teacher	150	Male=108 [72] Female=41 [27.33]				
BTBGTAUT	Years of Teaching	148 (2)		10.736	1	35	8.321
BTBMPSMA	Math Major	149 (1)	Yes=68 [45.33] No=81 [54]				
TCHINTERACT	Frequency of Teacher Interaction	149 (1)		1.978	1	3.5	0.468
BTBMPDMT	Professional Development in Mathematics Content	149 (1)	Yes=100 [66.67] No=49 [32.67]				
POSMBEL	Agreement with Positive Beliefs About Math 1=Disagree a Lot to 4=Agree a Lot	149 (1)		3.361	2	4	0.357
Instructional Practice Variable Name	**Description**	**N (msng)**	**Freq.**	**Mean**	**Min**	**Max**	**Std. Dev.**
BTBMSTUD	Class Size	149 (1)		36.389	19	49	5.406
BTBMTXBU	Use of Txtbk as Primary Basis for Lessons	134 (16)	Primary Source=94 [70.15] Supp. Source=40 [29.85]				
TCHHGHLVLM	Teachers Teach High Level Math (1=Never; 4=Every or Almost Every	149 (1)		2.275	1	4	0.515

	Lesson)						
BTBMCOMA	Students Use Computers During Math Lessons	148 (2)	Yes=8 [5.33] No=140 [93.33]				

Malaysia—School Characteristics Descriptive Statistics

School Characteristics Variable Name	Description	N (msng)	Freq.	Mean	Min	Max	Std. Dev.
BCBGASTD	Student Absenteeism	150	Less than 5%=98 [65.33] 5% or More=52 [34.67]				
BCBGSBED	% of Students Come from Economically Disadvantaged Homes	150	50% or Less=55 [36.67] More than 50%=95 [63.33]				
BCBMGAMC	Students Grouped by Ability	149 (1)	Yes=66 [44] No=83 [55.33]				
BCBMRRTM	Math Teacher Incentives	150	Yes=5 [3.33] No=145 [96.67]				

Philippines—Student Scores and Weights

Scoring Variable	Description	N (msng)		Mean	Min	Max	Std. Dev.
BSMMAT01	1st Plausible Value-Math	6917		378.793	74.544	706.390	85.078
BSMMAT02	2nd Plausible Value-Math	6917		378.146	103.911	721.270	85.502
BSMMAT03	3rd Plausible Value-Math	6917		377.141	95.073	712.736	86.318
BSMMAT04	4th Plausible Value-Math	6917		377.877	98.702	682.034	85.145
BSMMAT05	5th Plausible Value-Math	6917		378.604	103.085	722.862	85.941
Weight Variable	**Description**	**N (msng)**		**Mean**	**Min**	**Max**	**Std. Dev.**
TOTWGT	Total Student Weight	6917		201.698	63.363	605.837	62.965

Philippines—Student/Parental Background Descriptive Statistics

Student Bkgrd Variable Name	Descrip.	N (msng)	Freq.	Mean	Min	Max	Std. Dev.
BSDAGE	Student's Age	6868 (49)		14.791	10.333	19.000	0.984
BSBGSEX	Student's Gender	6905 (12)	Male =3958 [57.22] Female =2947 [42.61]				
FREQBSBGOLAN	Language of Test Frequently Spoken at Home	6883 (34)	Yes =410 [5.93] No = 6473 [94.07]				
BSBGHFSG	Student's Educational Expectation	5467 (1348)	Will Not Comp. Tert.				

			Ed. =2893 [41.82] Will Comp. Tert. Ed. =2676 [38.69]				
Parental Bkgd Variable Name	**Descrip.**	**N (msng)**	**Freq.**	**Mean**	**Min**	**Max**	**Std. Dev.**
MOTHERPOSTSEC	Mother Completed Post-Secondary Education	5609 (1155)	Yes = 1771 [25.60] No = 3991 [74.40]				
Student Education Variable Name	**Descrip.**	**N (msng)**	**Freq.**	**Mean**	**Min**	**Max**	**Std. Dev.**
HIGHMSELFCON	High Self-Confidence in Learning Math	6805 (112)	Yes =1962 [28.36] No = 4843 [71.64]				
HIGHMVAL	Students Highly Value Math	6826 (91)	Yes = 4991 [72.16] No = 1835 [27.84]				

<u>Philippines—Teacher Background, Teacher Quality, and Instructional Practice Descriptive Statistics</u>

Teacher Bkgd Variable Name	Description	N (msng)	Freq.	Mean	Min	Max	Std. Dev.
TCHFEMALE	Gender of Teacher	136 (1)	Male=98 [71.53] Female=38 [27.74]				
BTBGTAUT	Years of Teaching	131 (6)		11.412	1	37	8.476
BTBMPSMA	Math Major	136 (1)	Yes=83 [60.58] No=50 [36.50]				
TCHINTERACT	Frequency of Teacher Interaction	136 (1)		2.238	1	4	0.554
BTBMPDMT	Professional Development in Mathematics Content	135 (2)	Yes=111 [81.02] No=24 [17.52]				
POSMBEL	Agreement with Positive Beliefs About Math 1=Disagree a Lot to 4=Agree a Lot	135 (2)		3.416	1.6	4	0.403
Instructional Practice Variable Name	**Description**	**N (msng)**	**Freq.**	**Mean**	**Min**	**Max**	**Std. Dev.**
BTBMSTUD	Class Size	135 (2)		52.44	20	80	10.951
BTBMTXBU	Use of Txtbk as Primary Basis for Lessons	120 (17)	Primary Source=73 [60.83] Sup. Source=47 [39.17]				
TCHHGHLVLM	Teachers Teach High Level Math Skills	133 (4)		2.429	1.5	4	0.554

	(1=Never; 4=Every or Almost Every Lesson)						
BTBMCOMA	Students Use Computers During Math Lessons	129 (8)	Yes=14 [10.22] No=115 [83.94]				

Philippines—School Characteristics Descriptive Statistics

School Characteristics Variable Name	Description	N (msng)	Freq.	Mean	Min	Max	Std. Dev.
BCBGASTD	Student Absenteeism	133 (4)	Less than 5%=92 [67.15] 5% or More=42 [30.66]				
BCBGSBED	% of Students Come from Economically Disadvantaged Homes	133 (4)	50% or Less=64 [46.72] More than 50%=69 [50.36]				
BCBMGAMC	Students Grouped by Ability	137	Yes=45 [32.85] No=92 [67.15]				
BCBMRRTM	Math Teacher Incentives	136 (1)	Yes=22 [16.06] No=114 [83.21]				

Appendix B: Results with Non-Clustered Robust Standard Errors

The results obtained from running an OLS regression analysis on the pooled TIMSS data using four different model specifications and *without* using clustered robust standard errors are presented below. In Column (1), the general model specified in the analysis methods section was used. In the subsequent second, third, and fourth regressions, the three variables that were found to be significant in the previous analysis *using* the corrected standard errors (please see Table 1) were interacted with the country dummy variables for Indonesia and Malaysia to obtain the last three sets of results in columns (2), (3), and (4). These regressions were performed to highlight the differences in the size of the standard errors between the two methods of analysis, which would consequently lead to erroneous conclusions of statistical significance.

Variables	**Description**	**(1) General Model**	**(2) Model (1), Including Interaction With Use of Textbooks Variable**	**(3) Model (1), Including Interaction with Use of High-Level Teaching Skills Variable**	**(4) Model (1), Including Interaction with Use of Computers During Math Lessons Variable**
Country Variables					
IDNA	Indonesia	35.350*** (4.940)	30.008*** (2.906)	28.214*** (7.712)	34.260*** (2.356)
MYSA	Malaysia	131.833*** (12.010)	136.433*** (3.103)	151.828*** (7.586)	131.509*** (2.712)
Student Background Variables					
BSDAGE	Student's Age	-14.699*** (3.942)	-14.670*** (0.929)	-14.683*** (-0.929)	-14.709*** (0.929)
FEMALE	Student's Gender	-1.049 (1.286)	-0.961 (1.489)	-1.064 (1.488)	-1.043 (1.489)

FREQBSBGOLAN	Language of Test Frequently Spoken at Home	-19.482*** (3.503)	-19.376*** (1.936)	-19.404*** (1.938)	-19.594*** (1.939)
STUDEDEXPEC	Student's Educational Expectation	33.750*** (5.102)	33.806*** (1.843)	33.793*** (1.842)	33.674*** (1.843)
BSBGHFSG_MISS		6.923*** (2.310)	7.006*** (2.176)	6.904*** (2.176)	6.915*** (2.177)
Parental Background Variables					
MOTHERPOSTSEC	Mother's Education: Post-Secondary	21.209*** (3.757)	21.35*** (2.200)	21.244*** (2.200)	21.286*** (2.199)
MOTHERPOSTSEC _MISS		-9.474*** (2.359)	-9.410*** (1.945)	9.452*** (1.945)	-9.447*** (1.945)
Education Attitude Variables					
HIGHMSELFCON	High Self-Confidence in Learning Math	19.401*** (3.607)	19.431*** (1.742)	19.448*** (1.742)	19.432*** (1.744)
HIGHMVAL	Students' Highly Value Math	6.770*** (2.260)	6.831*** (1.688)	6.787*** (1.667)	6.905*** (1.669)
Teacher Background Variables					
TCHFEMALE	Gender of Teacher	5.501*** (1.808)	5.906*** (1.632)	5.460*** (1.650)	5.643*** (1.637)
TCHEXPER	Years of Teaching	0.543 (1.157)	0.538*** (0.104)	0.540*** (0.104)	0.547*** (0.104)
BTBTAUT_MISS		4.747 (3.878)	4.929 (4.583)	4.592 (4.516)	4.648 (4.512)
MATHMAJOR	Math Major	1.958 (1.482)	2.046 (1.553)	2.068 (1.558)	2.185 (1.556)
BTBMPSMA_MISS		17.156*** (4.161)	17.133*** (4.402)	17.280*** (4.076)	16.942*** (4.096)
TCHINTERACT	Frequency of	-3.997**	-4.477***	-3.705**	-3.809***

	Teacher Interaction	(1.694)	(1.423)	(1.426)	(1.411)
PROFDEV	Professional Development in Mathematics Content	9.879*** (2.632)	9.620*** (2.099)	9.703*** (2.101)	9.660*** (2.114)
POSMBEL	Agreement with Positive Beliefs About Math	4.119* (2.153)	3.753* (2.142)	4.309** (2.139)	4.524** (2.143)
Instructional Practice Variables					
BTBMSTUD	Class Size	0.004 (0.149)	0.033 (0.100)	-0.007 (0.099)	-0.003 (0.099)
BTBTEXTBK	Use of Textbooks as Primary Basis for Lessons	21.580*** (3.915)	16.622*** (2.319)	21.529*** (1.639)	21.511*** (1.645)
BTBMTXBU_MISS		17.466*** (3.447)	14.559*** (2.883)	17.066*** (2.805)	17.114*** (2.830)
IDNA*BTBMTXBU			9.46*** (3.321)		
MYSA*BTBMTXBU			-6.342** (3.049)		
TCHHGHLVLM	Frequency Teachers Use High Level Math-Teaching Skills	11.119*** (2.753)	11.342*** (1.366)	10.302*** (2.224)	10.8999*** (1.366)
IDNA* TCHHGHLVLM				2.881 (2.957)	
MYSA* TCHHGHLVLM				-8.952*** (3.040)	
BTBMCOMP	Students Use Computers During Math Lessons	39.438*** (5.271)	39.335*** (2.517)	39.122*** (2.529)	33.441*** (3.744)
BTBMCOMA_MISS		9.617***	9.365**	9.665***	9.843***

		(3.384)	(3.544)	(3.528)	(3.522)
IDNA* BTBMCOMP					9.967* (5.148)
MYSA* BTBMCOMP					1.223 (5.500)
School Background Variables					
BCBGASTD	Student Absenteeism	-12.275*** (2.715)	-11.779*** (1.822)	-11.649*** (1.818)	-12.566*** (1.805)
BCBGSBED	% of Students Come from Economically Disadvantaged Homes	-20.057*** (3.779)	-19.803*** (1.554)	-19.998*** (1.570)	-20.239*** (1.568)
BCBMGAMC	Students Grouped by Ability	13.433*** (2.996)	13.302*** (1.667)	13.705*** (1.660)	13.463*** (1.652)
BCBMRRTM	Math Teacher Incentives	3.710** (1.895)	3.554* (1.960)	3.675* (1.964)	3.486* (1.960)
Observations		16657	16657	16657	16657
R-Squared		0.326	0.327	0.326	0.326

Non-clustered, robust, weighted standard errors in ( ).

*** indicates significance at the 99% confidence level.
** indicates significance at the 95% confidence level.
* indicates significance at the 90% confidence level.