TEACHER CREDENTIALS AND STUDENTS’ MATHEMATICS PERFORMANCE ACROSS ASIAN COUNTRIES

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ABSTRACT

The purpose of this study is to analyze the impact of teacher credentials on the mathematics performance of students based on TIMSS 2011 Mathematics Scores of the top ten (10) and bottom ten (10) Asian performing countries. Exploratory procedure of data analysis via forced cluster analysis and formal test of statistical hypotheses through t-tests and regression analysis were used in the study. Results showed that there are four (4) out of six (6) teacher credentials namely; teachers with mathematics education major, teachers with mathematics major, induction program and supervised practicum have statistically significant bearing on the total quality of mathematics performance across Asian countries.

KEY-WORDS: cluster analysis, confirmatory methods, mathematics performance, teacher credentials

INTRODUCTION

Questions underlying teacher credentials as part of teacher qualifications on student performance are not new. Indeed, over the years, several observers of education process have explored and studied on this and found inconsistencies of the results as stated by American Association of Colleges for Teacher Education (AACTE 2010) as cited by Montalbo and Pogoy (2010). Some studies used measurable proxies such as teachers’ years of experience, level of professional development and level of educational degrees and failed to identify any direct link towards student performance in mathematics.

Goe (2008) indicated that researches on student achievement linked to teacher quality are not successfully identified. Clotfelter (2007) also cited that the quality of the student achievement differs in terms of teacher quality while Sawchuk (2011) also noted that the most important school-based factor that affects achievement is the teacher quality. Up to this time, there is no concluding study on the impact teacher credentials linked to students’ performance. However, information about teacher education collected from the forty-two (42) participating countries of Trends in International Mathematics and Science Survey (TIMSS) contains reliable and wide range of data about teacher credentials and student performance. The sheer volume of data collected is sufficient reason to embark on a detailed analysis of the impact teacher credentials on students’ performance.

Our study focuses on the teacher credential factors such as (1) percentage of mathematics major teachers, (2) percentage of mathematics education major teachers, (3) completion of induction program, (4) teachers’ qualifying examination, (5) teachers’ experience, (6) supervised practicum as they relate with the TIMSS 2011 mathematics scores of the selected Asian countries. The main focus of this study is to find out the teacher credentials that affect student performance in mathematics across Asian countries and to examine these teacher credentials as indicators of the teacher qualifications that influence the quality of mathematics teaching in the basic education of the country.

1. REVIEW OF THE LITERATURE

Ensuring elementary and secondary schools with effective teachers remains to be a tight spot across the world educational system according to Ingersoll (2007). Teachers who were not able to master the curriculum and were not able to meet the minimum standards for admission are some probable reasons for educational quality (UNESCO, 2004).
As cited by Yunus, Hamzah, Ismail (2008), it is recommended to have the seven domain of teacher’s professional knowledge to the subject matter, pedagogical content, other contents, curriculum, learners, educational aims, and general pedagogy. To obtain these components, the Malaysian University used two curriculums in training their secondary mathematics teacher. Teachers must first earn Bachelor of Science (Mathematics with education) degree or Bachelor of Education (Mathematics) degree as part of the undergraduate program followed by a Postgraduate Diploma of Education (DPE). This assures teachers’ quality programs.

A study done by Chang and Wu (2007) showed that on the first few years of mathematics teachers with math and science background, poor teacher-student interaction happened due to the inadequate instructional approach. But after four years in service, they already gain more confidence in teaching than those who are not specializing math and science.

Typically, lesser learning is produced by a beginning teacher than to those teachers with more experience. Hence, teachers grow their effectiveness over at least five years on the job as cited by Clotfelter, Ladd, Vigdor (2007). Certification proves that a teacher have fulfilled the required standards that are approved upon by the educational stakeholders (Leak and Farkas, 2011). Teacher certification has no renewal and it’s a lifelong validity. When the program is approved and completed, course credits certificates are given in Japan while in Korea; initial teacher’s certificate is awarded. The initial teaching certificate is valid to all countries except for Australia and U.S. This certificate is an indication that the teacher completed the preprimary necessity for teaching. On the other hand, there is no other certification required further than the education and curriculum in Hong Kong and Singapore (Wang, Coleman, Coley, Phelps, 2003).

According to the National Commission on Teaching and America’s Future (NCTAF), to have competent teachers in both content and pedagogy, certification and licensure are given consideration to improve student achievement (Sparks, 2004). Thus, teacher licensure also seems to matter (Clotfelter, Ladd, Vigdor, 2007).

In terms of induction program, Korea and Netherlands do not provide new teacher support programs. In Hong Kong, seminars and workshops are offered for the new teachers but there is no national policy on this. For countries like Singapore whose induction program is run by the national ministry, it is a requirement by the national government. In Japan, the state required a strong monitoring of the program. Teachers who attended the induction program are compensated either of the two: payment with the regular salary or reduced workload. But in Hong Kong, the teacher pays for it and repayment follows (Wang, et.al. 2003).

In the surveyed done by Educational Testing Center (ETC, 2003), all countries required student teaching or other in-school practical experiences. A practical experience ranges from three to four weeks in Japan and four to six weeks in Korea towards the end of their teacher education program. In Hong Kong, students are required to teach a minimum of eight to ten weeks before graduation. In Singapore, a total of ten weeks are required nine weeks in compulsory practicum and one week in school experience (Wang, et.al. 2003).

In Hong Kong, it is not required to complete the professional preparation for teaching to be employed. Teachers can begin teaching before or during the preparation and training (Ingersoll, 2007).

Frome, Nasaster and Cooney (2005) as cited by Goe and Stickler (2008), few studies point out that a teacher who is a graduate or undergraduate with mathematics as major is related to student higher achievement in high school. It is also suggested that percentage of teachers who undergo monitoring and induction program can be related to school-level achievement. Buddin and Zamarro (2009) indicated that there is a weak relationship between teacher credentials (experience and licensure) and student achievement.

### 2. RESEARCH DESIGN AND ANALYTICAL FRAMEWORK

This study made use of the bipolar analysis where the top 10 performing Asian countries who participated in TIMSS (2011) were contrasted with the bottom 10 performing Asian countries in terms of teacher credentials. The measurement of the teacher credentials are given in Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Code</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Mathematics Majors</td>
<td>Math Majors</td>
<td>Percent of every hundred</td>
</tr>
<tr>
<td>Percentage of Mathematics Education Major</td>
<td>Math Ed Majors</td>
<td>Percent of every hundred</td>
</tr>
</tbody>
</table>
Completion of Mentoring or Induction Program  
Passing a Qualifying Examination (e.g., licensing, certification)  
Percentage of Teachers having 5 or more years of experience  
Supervised Practicum During Teacher Education Program  

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cluster1 (Top 10)</th>
<th>Cluster2 (Bottom 10)</th>
<th>Grand Centroid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scores</td>
<td>584.1667</td>
<td>418.5000</td>
<td>468.2000</td>
</tr>
<tr>
<td>Math Majors</td>
<td>34.8333</td>
<td>48.2143</td>
<td>44.2000</td>
</tr>
<tr>
<td>Math Ed Majors</td>
<td>50.8333</td>
<td>29.1429</td>
<td>35.6500</td>
</tr>
<tr>
<td>Experience</td>
<td>78.3333</td>
<td>80.2857</td>
<td>79.7000</td>
</tr>
<tr>
<td>Licensure</td>
<td>0.8333</td>
<td>0.5714</td>
<td>0.6500</td>
</tr>
<tr>
<td>Induction</td>
<td>0.6667</td>
<td>0.3571</td>
<td>0.4500</td>
</tr>
<tr>
<td>Practicum</td>
<td>1.0000</td>
<td>0.5714</td>
<td>0.7000</td>
</tr>
</tbody>
</table>

Table 1: Definition of Variables under the Teacher Credentials

The data for this research study were based from the published TIMSS 2011 results. In order to obtain the comparison of the teacher credentials of the top performing countries and low performing countries in Asia we presented exploratory analysis that includes finding the profiles of these countries in terms of teacher credentials. To be concise, we referred this technique as “forced cluster analysis” although, technically speaking we have not performed real cluster analysis. With the profile exploration, we compared the two groups in terms of these variables either by using a simple t-test for independent samples or by a chi-square contingency analysis. Finally, for those variables found to be significant as a differentiating characteristic between the top performing countries and the low performing countries in Asia we proceeded to perform a regression analysis in order to ascertain their joint relative contribution in the Mathematics scores of the students in these countries.

3. RESULTS

In the preliminary data exploration, we performed a cluster analysis in such way that the top performing Asian countries are clustered as one and the low performing Asian countries are clustered as another. The different variables of each cluster were then analyzed and the results are shown in Table 2:

<table>
<thead>
<tr>
<th>Variables</th>
<th>t-value</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math Majors</td>
<td>2.20</td>
<td>Significant, p &lt; 0.041</td>
</tr>
<tr>
<td>Math Ed Majors</td>
<td>5.02</td>
<td>Very Significant, p &lt; 0.000</td>
</tr>
<tr>
<td>Experience</td>
<td>0.91</td>
<td>Not Significant, p &gt; 0.377</td>
</tr>
<tr>
<td>Licensure</td>
<td>1.41</td>
<td>Not Significant, p &gt; 0.177</td>
</tr>
<tr>
<td>Induction</td>
<td>2.47</td>
<td>Significant, p &lt; 0.024</td>
</tr>
<tr>
<td>Practicum</td>
<td>2.61</td>
<td>Significant, p &lt; 0.018</td>
</tr>
</tbody>
</table>

Table 2: Cluster Analysis of Low and Top Performing Countries in Asia

Tabular result showed that the top 10 performing Asian countries have greater percentage of mathematics education teachers, have higher percentage of passing the qualifying examinations for teachers, have more teachers who completed mentoring or induction program and have more teachers with supervised practicum during the teacher education program. However, in the bottom performing countries in Asia, there are more teachers who are mathematics majors and more teachers teaching mathematics in more than five (5) years in these countries.

After clustering, statistical testing of the variables takes place. Table 3 shows the results of the comparison between the TIMSS mathematics scores as it relates to the different teacher credentials.
Table 3 : Comparison of the TIMSS Math Scores Based on Teacher Credentials

Out of the six (6) variables used, four (4) were found to be statistically significant in relation to the TIMSS (2011) mathematics scores. These variables were the following: teachers with Mathematics major, teachers with Math Education major, complete induction program and the supervised practicum during the teacher education program.

Table 4 shows the analysis performed to ascertain the joint effects of these three (4) individually significant determinants of student performance in Mathematics:

The regression equation is

Scores = 514 - 0.49 Math Major + 3.09 Math Ed - 1.92 Experience + 63.9 Licensure + 11.3 Induction - 37.5 Practicum

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coef</th>
<th>SE Coef</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>514.1</td>
<td>167.1</td>
<td>3.08</td>
<td>0.009</td>
</tr>
<tr>
<td>Math Maj</td>
<td>-0.493</td>
<td>1.267</td>
<td>-0.39</td>
<td>0.704</td>
</tr>
<tr>
<td><strong>Math Ed</strong></td>
<td><strong>3.095</strong></td>
<td><strong>1.497</strong></td>
<td><strong>2.09</strong></td>
<td><strong>0.043</strong></td>
</tr>
<tr>
<td>Experien</td>
<td>-1.919</td>
<td>1.748</td>
<td>-1.10</td>
<td>0.292</td>
</tr>
<tr>
<td>Licensur</td>
<td>63.93</td>
<td>36.33</td>
<td>1.76</td>
<td>0.102</td>
</tr>
<tr>
<td>Inductio</td>
<td>11.33</td>
<td>39.97</td>
<td>0.28</td>
<td>0.781</td>
</tr>
<tr>
<td>Practicu</td>
<td>-37.54</td>
<td>52.34</td>
<td>-0.72</td>
<td>0.486</td>
</tr>
</tbody>
</table>

S = 70.13     R-Sq = 53.8%    R-Sq(adj) = 32.5%

Table 4 : Regression Analysis with TIMSS Mathematics Scores as Dependent Variable

Of the four (4) teacher characteristics analyzed, teachers with Math education majors turned out to have the highest influence on the final outcome as measured by the TIMSS mathematics. Together, these variables explained about 53.8% of the variance in the mathematics scores observed under TIMSS (2011) results.

4. DISCUSSION

This study has established the link between the teacher credentials and students performance which is a significant factor in the teaching of mathematics towards quality of basic education. Although many research studies have proven the link of the two, some have opposed and denied the relationship of the teacher credentials and students performance.

1. Math Ed majors registers significant impacts on the ultimate performance of the students. Teachers academic skills is a strong link to student achievement as cited by Wayne and Young (2003); Eide, Goldhaber and Brewer(2004) and Hanushek and Rivkin (2006). Being teachers having Mathematics as a major is not enough. For effective and efficient teaching, they need the pedagogy appropriate for the contents that they are teaching to their students. Ngo (2013) noted that pedagogical content knowledge is a critical component of teacher quality that link to student achievement.

2. Induction program supports professional advancement of new teachers. It is a pace in a range of expertise learning for teachers to sustain effective instruction, knowledge, and evaluation practices. According to Ingersoll (2011) students who had higher scores or gains taught by beginning teachers who had participated induction programs. Based from the analysis of this study, countries that required induction program produce good students. As cited by Montalbo and Pogoy (2010) having this support program would lead to student’s high performance in Mathematics and quality basic education. Thus, induction program is important in charting the course of quality for basic education.

3. In the teacher education programs, supervised practice teaching is found to be significant in the educational system. As cited by Boyd, Grossman, Lankford, Loeb, & Wyckoff (2008), the student teaching experience of the math teachers found to be most effective in the performance of the students. It gives the necessary skills of the math
teachers needed to teach their students. It gives exposure to future teachers of the real situations in the classroom and prepares them with the challenges they will face in the teaching profession.

4. The analysis indicates that experience and licensure are not indicators of quality educators. Number of teaching years does not have an impact on student’s performance. From the analysis of Goe (2008), hiring educators with more than five years of experience may not result to student improvement. The difference between certified and uncertified teachers is the level of knowledge and skills but these do not marked to single out the student performance gain. Thus, passing in the licensure examination is not an assurance that students will have a greater achievement in mathematics.

Teacher credentials (teachers with Mathematics and Math Education majors, supervised practice teaching, and teacher induction program) have significant impacts on students’ performance across Asian countries which, in turn spells the countries’ quality on basic education especially in Mathematics.

5. CONCLUSION
Teacher credentials (teachers with Mathematics and Math Education majors, supervised practice teaching, and teacher induction program) have significant impacts on students’ performance across Asian countries which, in turn spells the countries’ quality on basic education especially in Mathematics.

REFERENCES