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Exploring Relationship between Teaching Practice and Student Learning: Comparative Analysis Using Large Data Bases

Abstract This special issue introduction specifies several rationales for its focus on the relationship between teaching practice and student learning. Worldwide teaching reforms show some converging policy patterns with shared assumptions around the role of teaching practices in shaping students' learning outcomes as their bases. These assumptions and policy patterns are seriously challenged by various countering arguments and critiques. Such a contentious situation demands extensive and solid empirical knowledge for its productive resolution at a conceptual level and for guiding the development of the relevant teaching reforms in different countries. However, such knowledge is not available readily in the exiting literature, which is fragmented and limited, with few studies based on large databases from a comparative perspective involving non-Western countries and regions. It goes on to introduce four studies in the special issue that use international databases and comparative analyses involving different countries/regions and highlights their contributions to the much-needed empirical knowledge. Finally, it calls for further and more extensive research along this line of empirical exploration.

Keywords teaching reform, conceptual assumptions, international comparison

Introduction

This special issue has been developed to contribute to the understanding of the relationships between various teaching practices promoted by teaching reforms and students' achievements presumably produced by these teaching practices, also between teachers' self-efficacy beliefs of teaching and their teaching

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practices in different subject content areas from a comparative perspective. Asian educational systems are included as an important part of the comparison and the large-scale international data sets from the Trends of International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS) are used as data sources for developing such an understanding.

The choice of the above relationships as the focus of this special issue was based on two considerations. On the one hand, a number of shared assumptions about these relationships have been and are shaping school teaching reforms worldwide, which are fueling the development of contentious arguments and countering assumptions about them at scholarship and policy levels (Loomis, Rodriguez, & Tillman, 2008; Tatto, 2007). Together, these assumptions and the relevant debates call for extensive empirical knowledge about these relationships so that more productive policy discussions can be conducted and more effective policy initiatives can be developed to improve teaching and student learning. On the other hand, the existing literature is limited in several ways in offering us such knowledge (Kennedy, 2008; Seidel & Shavelson, 2007; Watkins & Biggs, 2001). Thus, the development of this knowledge is genuinely needed.

In the following paragraphs, the shared assumptions underlying worldwide school teaching reforms will be elaborated upon, and relevant debates over these assumptions and limitations of the existing literature in sustaining these assumptions and countering arguments will be explored. With this elaboration as a base, an explanation will be given as to how this special issue with its four studies addresses some of these limitations in the existing literature and helps verify some of these assumptions.

Worldwide Reforms and Similar Patterns

The emerging global economy is pushing many countries to develop their competitive edge in making innovative products appealing to a wider range of customers, finding effective ways to locate, obtain, distribute, and use their resources, and offering efficient service for such production and marketing worldwide (Spring, 1998). Such a competitive edge ultimately depends on a workforce that has strong literacy in mathematics and science, fluent oral, reading, and writing competence, and understanding about different cultural values (Longview Foundation, 2008). These in turn allow them to develop ideas for new products efficiently, communicate and collaborate with different people

effectively, and adapt and function flexibly in different contexts to solve various kinds of problems (Stromquist, 2002).

Such a shared need among nations for effective competition during a period of globalization is pushing the emergence of an economic imperative perspective that stresses the role of a nation's school system in helping produce such a workforce (Stromquist & Monkman, 2000). Consequently, it has become a national interest shared by many countries to demand its students to acquire and develop the knowledge, competences, and values that its workforce needs for active participation in the global economy (Burbules & Torres, 2000). This shared national interest drives teaching and curriculum reforms across different countries in three similar patterns (Delandshere & Petrosky, 2004; Loomis et al., 2008).

The first pattern is that many countries established or retuned their school curriculum standards to redefine what students need to learn based on the assumption that the existing school content fails to reflect the knowledge, competences, and dispositions required of an effective workforce in the global economy (Delandshere & Petrosky, 2004; Loomis et al., 2008). For example, in China, Republic of Korea, Japan, and Singapore where school curriculum is traditionally centralized, the governments are infusing new content, skills, and learning experiences into the existing national curriculum structure, whereas in Australia, Canada, England, Sweden, and the US, where curricula are traditionally decentralized, nationally centralized curriculum standards have been or are being established to reflect this need (Lee, 2001; Leong, 2007; Milewski, 2012; Sundberg & Wahlström, 2012; Yin, 2013).

The second pattern is that teachers in these countries are required to develop the particular kinds of teaching practices necessary to foster the knowledge, competences, and dispositions among their students effectively (Merryfield, 1997; Tatto, 2006) while the existing teaching practices are seen as not useful in helping develop this knowledge and these competences and dispositions (García, Arias, Murri, & Serna, 2010; Tatto, 2007). For example, concept-oriented mathematics teaching is seen as more useful than procedure-oriented mathematics instruction (Hiebert et al., 1997; Romberg, Carpenter, & Kwako, 2005). Inquiry-based instruction is assumed to be more effective than the traditional didactic approaches in science (Abd-El-Khalick et al., 2004; Anderson, 2002). Reading instruction that engages students in identifying important questions, locating, comparing, interpreting, evaluating, and synthesizing

information effectively on the internet and in the ICT environment has become ever more important than printed text-based reading instruction (Leu & Kinzer, 2000; Leu et al., 2011). Consequently, this need of changing teaching practices inspires scholarly discussions about the role of teachers' knowledge and beliefs about teaching in forming teaching practices and the necessity of changing their knowledge and beliefs about teaching as a way to transform their teaching practices (Pajares, 1992; Richardson, 1996; Shulman, 1987).

Third, the existing assessment systems have been or are being developed and retuned to reinforce the kinds of knowledge, competences, and dispositions that students are expected to learn for the global world in alignment with the centralized curriculum standards at international, national, and regional levels (Spring, 2008; Tatto, 2006). Students' achievements in these assessments have been or are being used as important bases to measure the effectiveness of teachers' teaching practices (Tatto, 2006; Zhao, 2010). For example, the results of international assessments such as TIMSS, PIRLS, and Programme for International Student Assessment (PISA), have become ever more influential in bringing about a convergence in the content focuses of curriculum reforms and changes at the national level (Nebres, 1999) and motivating the borrowing of curriculum and assessment policies from the countries with top-performing students (Romberg, 1997, 1999). Consequently, they are pushing the emergence of centralized curriculum standards and curriculum-based students' assessments at the national and regional levels and the alignment of students' assessment with teachers' performance in many countries (Spring, 2008).

Contentious Assumptions and Much-Needed Empirical Knowledge

Underlying curriculum and teaching reforms around the world are several shared assumptions. One of them is that teaching quality plays the most important role in shaping student academic performance (Darling-Hammond & Youngs, 2002) while the needs of national economic development are imperative in determining what and how students need to be taught (Stromquist & Monkman, 2000; Zhao, 2010). In relation to this assumption is the idea that teaching practices are central to teaching quality (Grossman, Hammerness, & McDonald, 2009; Hiebert & Morris, 2012) and that certain kinds of practices are more useful than others in

helping all students learn effectively in different subject content areas (Akkus, Gunel, & Hand, 2007; Smith, 1994; Smith III, 1996), especially those practices designed following the current understanding about how children learn and the nature of various subject content areas (Applebee & Langer, 1983; Bransford, Brown, & Cocking, 1999; Romberg, 1992). The third assumption is that teachers' existing practices can be changed when their conceptions and knowledge about teaching are transformed (Ball & Bass, 2001; Grossman, 1990; Kennedy, 1991).

In the Western literature, each of these assumptions is seriously challenged on different grounds. First, scholars from a critical perspective question the approach to reforming curriculum and teaching according to the economic imperative perspective as an unjust and twisted understanding of the needs and effects of globalization on a country's education (Apple, 2001; Burbules & Torres, 2000). Such an approach blinds people from seeing the questionable results of the irresponsible and greedy nature of cross-national corporations and companies (Berliner & Biddle, 1995) and the detrimental influences of globalization on the widening wealth gap between and within countries, destruction of local cultures and economies, devastation of the natural environment and resources, creation of social inequality, and abuse of immigrants (Apple, 2011). From this perspective, the curriculum standards and the relevant teaching practice that are effective in serving the needs of global economy without raising any questions can do more damage than good to students and society alike (Apple, 2001; Freire, 1970; Sleeter, 2008). Thus, an effective teaching reform should focus on the development of students' critical social consciousness about the reality of globalization and the knowledge, skills, and disposition that allow them as responsible citizens to actively participate in the democratic process and struggle in reconstructing a society of justice and equity (Burbules & Torres, 2000; McLaren & Farahmandpur, 2001).

Second, many scholars contend with the idea that reform-minded teaching practices can help all students learn as effectively as expected on two grounds. Some cast doubt on whether such reformed teaching can be more effective than traditional teaching practices in helping students learn as expected when basic knowledge and skills as well as the practices of these knowledge and skills are left out in these practices (Bracey, 1997; Geary, 1994; Wu, 1999). Others challenge the idea that reformed teaching practices can help all students learn effectively regardless of their social, cultural, and ethnic differences and argue

that the effectiveness of teaching practices depends ultimately on the kinds of students in the classrooms and their different social, cultural, and ethnic backgrounds (García, Arias, Murri, & Serna, 2010; Ladson-Billings, 1997). Following this line of thinking, teaching practices should be culturally responsive to students' particular cultural and racial backgrounds or social economic statuses in order to be effective (Gay, 2000; Ladson-Billings, 1995).

Finally, the assumption that changing teachers' beliefs and knowledge can lead to the successful transformation of teaching practices is also questioned for its failure to consider teaching practices as deeply rooted in teachers' own teaching and learning experiences and cultural values, intimately integrated into the persistent tradition and culture of the teaching profession, intrinsically tied to social and school organizations, and strongly shaped by fluctuating classroom situations (Clandinin & Connelly, 1995; Kennedy, 2010; Lipsky, 1980; Lortie, 1975; Sykes, Bird, & Kennedy, 2010). These experiences, cultural traditions, organizations, contexts, and situations can easily defuse the reform efforts (Kennedy, 2010; Labaree, 2000) and make the transformation of teaching through changing beliefs and knowledge either impossible or if possible, a gradual long term process (Hiebert, Gallimore, & Stigler, 2002; Stigler & Hiebert, 1999). Therefore, a teacher community-based approach to improving teaching practice, contextualized in the school, is seen as more useful (Borko, 2004; Cochran-Smith & Lytle, 1999; Hargreaves & Fullan, 2012), especially when this approach involves teachers in planning collaboratively, observing mutually, and examining publicly their lessons (Hiebert et al., 2002; Stigler & Hiebert, 1999).

These contentious assumptions call for extensive and solid empirical knowledge about the two kinds of relationships necessary for constructive scholarly conversations and productive outcomes in terms of policy. As mentioned earlier, these are the relationship between different kinds of teaching practices emerging from the contentious discussions over worldwide teaching reforms and the academic achievements of students from different academic, cultural, ethnic, and social economic backgrounds, and the relationships between various types of teacher beliefs and knowledge of teaching, and different kinds of teaching practices in diverse subject content areas and curriculum, teaching, and school contexts. Not only is this empirical knowledge important from a scholarly perspective, but also it is necessary to guide effective, reliable, and cautious policymaking in different countries. It is especially valuable considering the fact

that such policy decisions are costly in terms of the financial input, administrative work, investment of emotion, time, and effort by individual teachers, and their extensive social impacts.

Fragmented Empirical Literature and Inconsistent Evidence

While important from a scholarly perspective and necessary in terms of policy, an empirical understanding about these two relationships cannot be readily constructed on the basis of the existing literature in the field of teaching and student learning due to its fragmented nature and limitations in several ways. For the relationship between teaching practices and student learning outcomes, the three relevant bodies of literature each have their own limitations.

First, many studies examine the relationships between teaching quality and students learning by skipping the direct examination of actual teaching practices. One such line of research focuses on the influences of teachers' professional qualifications on student learning, such as numbers and kinds of courses, test scores, or grades in the coursework that teachers had in their teacher preparation programs as well as their teaching certification, licensed content areas, and gradual level or further professional development (Cochran-Smith & Fries, 2001; Darling-Hammond, 2000). The relevant review of studies along this line showed either weak or insignificant influences of these teacher qualifications on students' achievements with little attention to how these qualifications impacted teaching practices (Wayne & Youngs, 2003).

Another line of inquiry examines the influences of teachers' knowledge on students' achievements (Ball, Thames, & Phelps, 2008; Pajares, 1992; Shulman, 1987). A few studies examining the influences of teachers' knowledge on students' achievements in mathematics only showed a weak or insignificant relationship (Hill, Rowan, & Ball, 2005; Kersting, Givvin, Sotelo, & Stigler, 2010).

The last line of inquiry inferred the influences of particular kinds of teaching practices on students' learning by comparing differences of pre- and post-achievement scores between various groups of students who are exposed to different kinds of teaching practices mostly without direct analysis of the quality and characteristics of teaching practices that different groups of students were actually exposed to (Alicias, 2005; Hanushek & Rivkin, 2010; Harris, 2011).

These studies often involved small numbers of students in similar school contexts, which often showed varied results in different subject content areas based on the relevant literature review (Seidel & Shavelson, 2007).

Second, many studies characterize different kinds of teaching practices without examining directly the influences of these teaching practices on the achievements of students who are actually exposed to such instructions, which include two lines. One line of this research analyzes lesson observation, such as those from the process-product approach to research on teaching before the 1980s (Brophy, 1989), and the videotaped lessons, for instance those conducted by the TIMSS video study (Stigler & Hiebert, 1997). This line is developed to identify the quality and characteristics of teaching practices either against theory-based criteria (Ladson-Billings & Darling-Hammond, 2000; Silvestro et al., 1993) or by characterizing differences between the lessons from the classes, schools, and countries where students showing higher performance levels and those where students had lower performance levels (Perry, 2000; Stigler & Hiebert, 1999; Stigler, Lee, & Stevenson, 1987).

The other line includes qualitative studies on teaching practices of individuals and groups of teachers that analyze the quality and patterns of teaching practices with a focus on engagement of students' in learning activities and the chances of such teaching for students learning outcomes (Lampert, 1990; Stigler & Stevenson, 1991; Wang & Paine, 2003). This line helps develop a deeper understanding about the discourse of particular teaching practice, its challenges, and opportunities for students' learning and raises questions about particular kinds of teaching practice (Lampert, 2010) while studies of this kind often lead to conflicting results that are open to multiple interpretations.

Third, a number of correlation-based surveys are developed to examine the influences of teachers' general classroom teaching behaviors and their subject-specific teaching and learning activities on student learning outcomes (Seidel & Shavelson, 2007). The influence of general classroom teaching behaviors on student learning outcomes is very small while the effects of subject-specific teaching and learning activities are diverse across subject areas as demonstrated by a systemic literature review (Seidel & Shavelson, 2007).

However, this kind of study is often limited in two ways. They mostly involve small samples without serious attention paid to controlling for confounding influences, such as students' social, cultural, and ethnic differences, and thus

their influences on student learning outcomes can be compromised when students' social economic status, cultural, and ethnic backgrounds are considered (Lubienski, 2001; Lubienski & Shelley, 2003). Most of them are also conducted with little attention to the influences of contextual differences and are guided by conceptual frameworks or assumptions developed in western contexts. The theories generated from the findings of these studies in the West often lose their predictive power when applied to other non-western countries, such as Chinese contexts (Chan, 2008; Watkins & Biggs, 2001).

The existing literature examining the relationship between teachers' beliefs and knowledge of teaching also has several limitations. Research on the relationship between teachers' knowledge for teaching and their teaching practices is mostly qualitative in nature with limited possibility of generalization for the purpose of policymaking while the relevant systematic and quantitative research is under development (Hill & Charalambous, 2012). Research on the relationship between teachers' beliefs about teaching and their teaching practices shares similar characteristics with conflicting and inconsistent findings based on the review of the relevant literature (Richardson, 1996; Thompson, 1992).

Therefore, systematic and quantitative research needs to be developed to examine the relationships between various teaching practices promoted by teaching reforms and the relevant students' achievements and between teachers' beliefs and knowledge of teaching and their teaching practices in different subject content areas. In this inquiry, appropriate attention should be paid to students with different social, economic, cultural and ethnic backgrounds and the influences of different contexts of education. Such research plays a unique role in contributing to the much-needed empirical knowledge that is important for the verifications of scholarly assumptions and valuable on a policy level in relation to worldwide teaching reforms.

Special Issue's Focuses and Contributions

In this special issue, four research articles are included, three of which examine the relationship between different kinds of teaching practices and students' achievements in mathematics, science, and reading competence areas and one explores the relationship between teachers' efficacy beliefs in teaching mathematics and their teaching practices. These reports use the data sets from

large-scale international databases such as TIMSS 2011 and PIRLS 2011 and verify several theoretical assumptions about the above relationships from a comparative perspective.

The study by Cheng, *Quality Mathematics Instructional Practices Contributing to Student Achievements in Five High-Achieving Asian Education Systems: An Analysis Using TIMSS 2011 Data*, compares types of quality mathematics instructional practices that affect the mathematics learning of highly performing students across Hong Kong, Korea, Japan, Singapore, and Chinese Taipei by controlling of parents' education levels. Through this comparison, it examines whether and to what extent the theoretically assumed effectiveness of conceptual and procedural based mathematics-teaching practices on students' mathematics is evident and whether and to what extent effective teaching practices are consistently developed across the five high-performing Asian countries and regions as argued in the literature.

As it turns out, among the conceptual mathematics teaching practices measured, only one exerted positive influence on student performance in Japan, while in all the other countries and regions they had either negative influences or no influence at all. Similar findings were also identified for various components of procedural mathematics teaching. Together, it demonstrated no consistent components in either teaching practices across the five Asian countries and regions. These findings challenge the theoretically assumed positive effectiveness of conceptual mathematics teaching practices on students' mathematics learning outcome promoted by mathematics teaching reforms in many countries, the assumed effectiveness of procedural mathematics teaching supported by the opponents of conceptual teaching, and the presumed uniformity of effective mathematics teaching practices across different high performing Asian countries and regions suggested in the Western literature.

Gao in her study, *Relationship between Science Teaching Practices and Students Achievement in Singapore, Chinese Taipei, and the US: An Analysis Using TIMSS 2011 International Data*, examine whether or to what extent the assumption that has been driving science education reform in many countries is borne out, with control of students' social economic status and self-confidence in science learning from a comparative perspective. This assumption is that inquiry-based instruction is more effective in influencing student science achievement than traditional didactic teaching with higher students' science performance. Thus, it indirectly verifies whether and to what extent the culturally

relevant pedagogy assumption can be sustained in cross-national/regional contexts.

The study found that only two of eight inquiry-based teaching practices measured were positively related to the lower performing students' science achievements in Chinese Taipei, all the other inquiry-based science teaching items exerted no influence on lower, average, and higher performing students in any of the three countries and one region. In contrast, the components of the didactic science teaching practice items were either negatively associated with or had no influences on the science achievement of low, average, and highly performing groups of students in the three countries and region. The study posed a challenge about the assumed effectiveness of inquiry-based science teaching and raised a question about the universal application of a culturally responsive pedagogy theory in interpreting the relationship between various science teaching practices and students' science performances with various cultural backgrounds.

In the article, *Relationship between Computer-Based Reading Activities and Reading Achievements among Hong Kong and U.S. Students: A Comparative Study Using PIRLS 2011 Data*, Li and Wang explore the influences of various components of computer-assisted reading instruction on students' reading competences presumably useful for the information society in the two places by controlling the social economic statuses and gender factors. Through this examination, it further verified whether and to what extent the assumed effectiveness of the internet and ICT based instruction in developing these skills and the role of the cultural structure of language on the reading competence development in the two places.

The study found that the computer-based reading instructional activities that helped or failed to help students develop important reading competence in one place did not have the same effects on helping students develop literacy performances in other places. While socioeconomic status contributed significantly to the reading achievements of U.S. students, it was surprisingly and negatively associated with the reading achievements of Hong Kong students. These findings raise a question about the assumed universal effectiveness of computer-assisted reading instruction on students' competences in using important reading processes in reading for personal experience and information. They support indirectly the assumed role of unique language structures in a

particular culture, nation or place on students' reading performance and challenge the assumed positive influence of students' family socioeconomic status on their reading achievement, a relationship that is supported empirically in Western contexts.

The last study by Shi, *Relationship Between Teacher Efficacy and Self-Reported Instructional Practices: An Examination of Five Asian Countries/Regions Using TIMSS 2011 Data*, examines the theoretically assumed positive influence of teachers' efficacy beliefs on their teaching of mathematics and whether such influences consistently exist in Hong Kong, Korea, Japan, Singapore, and Chinese Taipei, where students often demonstrate higher mathematics performances in the international comparisons. Therefore, it further verifies whether and to what extent these relationships are consistent across the five countries and regions as predicted by the popular self-efficacy theory supported by studies conducted mostly in western contexts.

The study found that in general, the levels of teachers' efficacy in teaching mathematics were much lower than the international norms, their efficacies in teaching mathematics were not always statistically and positively related to their instructional practices, and there were no consistent patterns of any positive relationship in light of specific efficacy items across the five Asian countries and regions. Together, these findings challenge the theoretical assumption about the positive relationship between teacher efficacy and instructional practices and support indirectly the influences of culture on teachers' efficacy in mathematics teaching. It suggests that teachers with higher efficacy in teaching mathematics do not necessarily provide higher quality instruction to engage students in learning mathematics across the five Asian countries/regions.

As I conclude this special issue introduction, it is my hope that it will help alert readers to the complex situation we are facing in sustaining empirically the relationships between teacher practices and student learning outcomes and between teachers' beliefs and knowledge about teaching and their teaching practices central to worldwide teaching reforms. On the one hand, extensive and solid empirical knowledge about these relationships is necessary to facilitate the contentious debates over the assumptions about the reform and offer a knowledge base for useful policymaking relevant to the teaching reform happening in many countries. On the other hand, the existing relevant empirical literature is not able to offer such knowledge at the present time. We hope the four research reports in

the issue will inspire more extensive, deeper, and continued examination of these issues, rather than bringing them to a close. In this examination, comparative studies based on a large database in various content areas should play an irreplaceable role.

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