



Teaching transformation under centralized curriculum and teacher learning community: Two Chinese chemistry teachers' experiences in developing inquiry-based instruction[☆]



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HIGHLIGHTS

- Centralized curriculum cannot warrant teachers to implement the reform.
- Teaching learning community is not sufficient to warrant teacher change.
- Interactions between standards, beliefs and learning communities are complex.

ARTICLE INFO

Article history:

Received 6 August 2013

Received in revised form

15 July 2014

Accepted 18 July 2014

Available online 7 August 2014

Keywords:

Inquiry-based instruction

Teacher-learning community

Centralized curriculum

ABSTRACT

The establishment of centralized curriculum standards and school-based teacher learning communities are presumably necessary to reform science teaching towards inquiry-based instruction in many countries. Drawing on interview, document, and unit plan data from two high school chemistry teachers in China, this study examines these assumptions. Findings indicated that both teachers developed different kinds of science teaching practices despite working under the centralized science curriculum and school-based teacher learning communities. Different teaching experiences of the two teachers and their school cultures of teaching interacted with the centralized curriculum and teacher teaching community to consequently shape their teaching practices in different ways.

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Inquiry-based science teaching stresses teachers' role in supporting students to investigate natural phenomena in the same way that scientists construct knowledge within various scientific communities (Abd-El-Khalick et al., 2004; Chang & Mao, 1999; Hofstein, Navon, Kipnis, & Mamlok-Naaman, 2005; Roehrig & Garrow, 2007). Such a teaching practice is seen powerful in helping students develop high quality science competencies (Ertepinar & Geban, 1996; Keys & Bryan, 2001; Lee & Paik, 2000) central to the effective social, economic, and political development of a country (Jenkins, 2009).

Consequently, the inquiry-based science teaching has become a central focus of science teaching reforms over the past 20 years in Australia (Australian Curriculum, Assessment and Reporting

Authority, 2012), England (Department for Education, 2013), US (National Research Council, 1996, 2000, 2012), and other European countries (Jenkins, 2009). Similar to this situation in the western world, scientific inquiry has also become both the method and goal of science learning in the science education reform in China based on the similar reasons (Chinese Ministry of Education, 2001a, 2011b; Wang, Zhang, Clarke, & Wang, 2014).

Among the policy initiatives, two have been popularly used to help teachers learn to teach inquiry-based instruction in many western countries. One is to establish the centralized curriculum standards and curriculum-based assessment in the places where the curriculum and assessment are decentralized, such as Australia (Australian Curriculum, Assessment and Reporting Authority, 2012), England (Department for Education, 2013), US (National Research Council, 1996), and other European countries (Jenkins, 2009). The assumption is that the powerful, specific, and well-aligned curriculum and assessment systems can help shape teachers teaching practice and outcomes of student learning (Cohen & Spillane, 1992). However, such centralized curriculum

[☆] We greatly appreciate the participating of the chemistry teachers from two high schools of Beijing, China in this study.

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and assessment systems are often conceptually contentious since they are perceived to camouflage for the deep social, economic, and political causes for inadequate student learning (Apple, 1996, 2001). Their effectiveness in moving teachers to the reform goal is assumed difficult to verify empirically as such curriculum and assessment systems are emerging (Hiebert, 1999).

The other is to develop the school-based teacher learning communities in which teachers plan, teach, observe, and discuss their teaching with each other (Garet, Porter, Desimone, Birman, & Yoon, 2001; Hargreaves, 1994; Little, 1982), such as professional learning communities in the US (McLaughlin & Talbert, 2006) and England (Bolam, McMahon, Stoll, Thomas, & Wallace, 2005), collaborative teacher groups in the UK (Dudley, 2013) and Canada (Schnellert, Butler, & Higginson, 2008). In spite of their variations, a shared assumption is that these communities can help teachers open their classrooms for public examination (Cochran-Smith & Lytle, 1999; Darling Hammond, 1997; Fullan, 2007), push them to depend on each other in learning to teach (Little, 1990; McLaughlin, 1993; Putnam & Borko, 2000), and develop effective teaching practices gradually (Stigler & Hiebert, 1999). Nevertheless, these school-based teacher learning communities are perceived as culturally scripted (Stigler & Hiebert, 1999) and contextually situated (Borko, 2004) and thus, the effective school-based teacher learning community in one place may not work effectively when it is implemented in the other (Fernandez, 2002; Fernandez & Cannon, 2005).

Some scholars (Hargreaves, 1994; Porter, McMaken, Hwang, & Yang, 2011) envision the positive effects of these reform policies in changing teachers' teaching practice as intended in the western countries as these policy initiative will help create a context in which teachers are hard to hide their struggle in teaching and have to rely on each other to improve their teaching practice (Little, 1990; McLaughlin, 1993; Putnam & Borko, 2000). Others (Cochran-Smith, 2001; Hargreaves & Dawe, 1990) suggest that curriculum standards and contrived teacher collaboration on teaching are not sufficient to warrant the teaching reform as teachers' personal experiences of teaching (Clandinin & Connelly, 1995; Craig, 2001) and school teaching culture (Kardos & Johnson, 2007) can interact with the centralized curriculum and assessment system and school-based teacher learning community to compromising their effects. Neither side has sufficient empirical evidences to prove their cases.

In some Asian countries, such as China (Wang et al., 2014), Japan (Lewis & Tsuchida, 2006), and Singapore (Poon, Lee, Tan, & Lim, 2010), the centralized curriculum and curriculum based assessment systems have already been established for many years. The policy initiative is to change the focus of the already established curriculum standards and relevant assessment system for the purpose of science teaching reform. Although varied in the forms and names, the school-based teacher learning communities have also been developed in some Asian countries, such as teaching research groups in China (Huang & Bao, 2006; Paine, 1990; Paine, 1997; Tang & Shao, 2013; Wang & Paine, 2003) and lesson study groups in Japan (Lewis & Tsuchida, 2006; Yoshida, 1999). The policy initiative is to implement science teaching reform through the existing structure of school-based teacher learning communities in these countries.

The inquiry-based science teaching reform under the influences of established centralized curriculum standards through the existing school-based teacher learning communities make the Asia countries, such as China and Japan, unique to examine the following two questions. Whether or not are the school based teacher learning community and centralized curriculum and assessment systems sufficient to change science teaching towards inquiry-based instruction? What are the role of teachers' personal teaching experiences and the culture of teaching in the school in

facilitating or compromising the intended outcome of science teaching reform under the influences of centralized curriculum standards through school-based teacher learning community? Drawing on qualitative data from two Chinese chemistry teachers who were working in different schools in the same district, this study examines these questions.

1. Literature bases

1.1. Theoretical frameworks

This study is framed through two theoretical lenses. The first is the theory of curriculum, teaching, and assessment alignment that defines five characteristics of effective curriculum policy that would shapes teachers' quality instruction (Porter, 1994; Porter, Floden, Freeman, Schmidt, & Schwille, 1988). These characteristics are: (1) The curriculum content represents the legitimate knowledge and reflects the needs of society and students that cannot be compromised by individual teachers' idiosyncratic preferences, (2) the curriculum has the authority to reward or punish teachers for meeting or not meeting its goals and requirements, (3) its requirements, supplemental materials, and teaching suggestions are specific for teachers to understand and use in teaching, (4) its standards, materials, and assessments are aligned with each other in sending consistent messages to teachers, and (5) it remains constant over time so that teachers can refine and develop their relevant beliefs, knowledge, and experience (Porter, 1994; Porter et al., 1988).

The curriculum and assessment system with these characteristics is often framed as the centralized curriculum mandated at national level (Stevenson & Baker, 1991), against which the inadequate teaching practice and student academic performances in the decentralized curriculum system, such as those in the US school systems, is often explained (Cohen & Spillane, 1992). Through this theoretical lens, this study analyzes the characteristics of the national curriculum, relevant materials, and assessments under which participants of the study teach and the role that these curriculum policies play in shaping the nature of science teachers' teaching and their efforts to change towards inquiry-based practice.

The second theoretical lens is the theory of practice learning community, which sees one's learning of a practice as a legitimate peripheral participation in the activity of practice community (Lave & Wenger, 1991). This theory suggests that the development of one's knowledge is assumed to be situated in the physical and social contexts of its use through his or her interactions with these contexts, which influence not only what they learn but also how they learn (Greeno, 1997; Greeno, Collins, & Resnick, 1996). Effective learning presumably occurs in the community of practitioners who have developed common interests, commitment, competences, joint activities, and collaborative relationships that allow its members to share information, learn from each other, and contribute to the collective repertoire of resources, experiences, tools, and ways of addressing recurring problems (Wenger, 1998).

Following this theory, teacher learning is seen as situated in a particular school-based learning community composed by teachers who interact with each other to shape their relationship and form the specific culture that defines what and how they learn to teach (Borko, 2004; Putnam & Borko, 2000). An effective school-based learning community often shares several important characteristics (Bolam et al., 2005; Kruse, Louis, & Bryk, 1995). Teachers share a core set of beliefs and desired behaviors about teaching practices, open their classroom for public examination by using observational, critique, and analytical tools. In their discussion of each other's teaching, the focuses are on student learning and effective teaching strategies and they share, modify, and create knowledge of

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