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RESEARCH ARTICLE

David Yun DAI, Kathryn A. GERBINO, Michael J. DALEY

Inquiry-Based Learning in China: Do Teachers Practice What They Preach, and Why?

Abstract China is undergoing an education reform that calls for a change from a rigid, fixed curriculum and didactic pedagogy to a more flexible, school-based curriculum and more inquiry-based pedagogy. This study investigated the extent to which Chinese middle and high school teachers (a) endorse an inquiry-based approach and underlying learning principles, (b) practice this mode of teaching, and (c) believe that the approach is practically viable in the current educational contexts in China. A structured survey was developed to solicit Chinese teachers' responses to the above three issues. A total of 582 valid responses were collected, representing middle and high schools in different geographic locations. The results show that Chinese teachers are receptive to inquiry-based pedagogy but find practical constraints in fully implementing it. Several cultural and pragmatic reasons are explored. Policy implications are discussed with respect to teacher education/development, capacity building for the new pedagogy, and teaching/evaluation alignment. Finally cultural issues are discussed regarding using inquiry-based learning to enhance critical thinking and nurture independent thinkers.

Keywords inquiry-based learning, education reform, teacher development, high-stakes testing

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David Yun Dai (✉)
Division of Educational Psychology and Methodology, University at Albany, State University of New York, Albany, NY 12222, USA
E-mail: ddai@uamail.albany.edu

Kathryn A. GERBINO
Capital Region BOCES of New York State Albany, Albany, NY 12205, USA

Michael J. DALEY
Department of Educational Administration and Policy Studies, University at Albany, State University of New York, Albany, NY 12222, USA

Introduction

Education Reform in China has been under way for many years since the Ministry of Education issued its first policy document "Guidelines for Basic Education Curriculum Reform (Trial)" in 2001, officially calling for sweeping curriculum reform across the nation. The document specified six objectives for the education reform:

- a change in *mode of learning* from passive knowledge absorption to active learning and knowledge construction;
- a change in *curriculum structure* from overemphasis on discipline-based knowledge to Integrated and adaptive approaches to knowledge;
- a change in *curriculum content* from a focus on book knowledge to connecting school learning to the broader scientific, technological, and social developments and student experience and interests;
- a change in *pedagogy* from lecturing/recitation/rote learning to inquiry- and problem-based learning, in the hopes of helping students develop information searching and processing skills and communication/cooperation skills as well as critical thinking and creative problem solving skills;
- a change in *evaluation* from a focus on selection and placement to one on improving learning and instruction, and
- a change in *curriculum administration* from central control to multi-level management adaptive to regional, local school and student needs.

The curriculum reform agenda echoes in many ways of Dewey's (1933) philosophy of education, which places a premium on inquiry-based learning and critical examination of facts and knowledge vis-à-vis real world problems as the essence of "being educated." Inquiry-based learning, in this sense, is not merely a pedagogical technique, but a way of life. It not only calls for a change in teaching and learning habits, but also entails deep change in values embodied in education. Students are encouraged to actively participate in exploration and inquiry, critically examine a particular claim rather than accept it as self-evident, and develop their identity as independent thinkers and informed, responsible citizens.

Pedagogically, inquiry-based learning engages learners' minds in puzzling out things, examining assumptions, carrying out mental experiments or real ones, developing well-reasoned arguments by gathering and evaluating evidence, fashioning solutions to problems meaningful to the learners, and envisioning alternative possibilities, and so on and so forth. Scholars who have helped shape this pedagogical philosophy include John Dewey (1933, 1997), Alfred Whitehead (1957), Jerome Bruner (1979), Ann Brown (1997), John Bransford (Bransford, Sherwood, Vye, & Rieser, 1986; Bransford, Brown, & Cocking, 2000), Giyoo

Hatano (1988), and David Perkins (1995), among others. Inquiry-based learning, broadly defined, includes a host of pedagogical models that share a family resemblance in that it emphasizes knowledge as personally constructed through active engagement and inquiry, albeit instructionally mediated in school, rather than transmitted unidirectionally from the teacher to the student (hence constructivism; see Tobias & Duffy, 2009). *Guided discovery*, developed by Brown and Campione (1994), is representative of early attempts at inquiry-based learning in science. There are recent extensions of this model, such as *productive disciplinary engagement* (e.g., Engle, in press; Engle & Conant, 2002), which features four principles for organizing learning activities: problematization, (student) authority, accountability, and resources. *Knowledge building*, is another model independently developed by Scardamalia and Bereiter (2006), initially implemented in reading and writing areas and now expanded widely to other school subjects (see Zhang, in press; Zhang, Scardamalia, Reeve, & Messina, 2009). Inquiry-based learning is most prominently featured in science teaching (Duschl & Grandy, 2008). Underlying this new pedagogy is the assumption that science education is not merely about knowing and committing to one's memory many scientific facts and theories but understanding how scientific knowledge is generated and how to evaluate knowledge claims and conduct scientific research. In short, science education is more than inculcating "what we know"; it should also gives students a sense of "how we know" and "why we believe what we know over alternatives" (Duschl & Duncan, 2009, p. 311). Goals of Inquiry-based learning, then, suggest a new level of cognitive (and metacognitive) sophistication not tapped into by the traditional pedagogy.

From a wealth of the literature on learning and teaching, the following tenets of inquiry-based learning can be drawn:

- *Students* actively *participate in learning and demonstrate active cognitive engagement*. Knowing (not just transmission of knowledge) is treated as a living experience and inductive process through observation, reasoning (sometimes argumentation), and active experimentation, and the need for knowledge becomes a major driving force for knowing and learning;
- *The teacher serves as a facilitator of knowing*, arousing interest and curiosity and assisting in investigation and reasoning, rather than a conduit of prescribed knowledge;
- Knowledge *is treated metacognitively as constructed models of some important aspects of the world (or history) but subject to further testing and modification*. There is a clear balance between content (what students should know), process (how students learn to think), and product (what students can do and produce with the new learning) in the curriculum.
- *There is a strong presence of active guidance in teaching* that enlists and harnesses students' sensitivities, inclinations, and abilities, helps students

envision alternative possibilities, and moves them toward a more principled, systematic way of interpreting and organizing one's experience and new information;

- *Classroom social climate is characterized by openness to different possibilities and support for exchanges of different opinions and arguments*; students are free from social coercion and inhibition when their feeling and thinking about important subjects and topics are concerned;
- *Assessment (teacher-, peer-, and self-assessment) is used to enhance learning and inform* teaching, rather than used solely for accountability; students take responsibility for and ownership of their own learning.
- *The* ultimate *test of successful learning is not reproductive use of knowledge (routine expertise) but productive, generative learning (adaptive expertise)*. Thus, knowledge transfer is a distinct goal of inquiry-based learning.

Inquiry-based learning is a curricular and pedagogical imperative in the United States largely because of the historical emphasis in education on critical thinking and productive use of knowledge for real life problem solving (Dewey, 1933). In China, inquiry-based learning is a relatively new idea embedded, but not always articulated, in the reform initiative. The call for education reform took place largely in response to three main problems: the preparation of an effective Chinese workforce for the 21st century, which is the main impetus in view of the rapid economic and social development in China, a rigid text-based curriculum mandated from top down for decades, and the didactic nature of teaching deeply rooted in the education system in China, which are seen as at odds with the main goals of producing a workforce capable of critical and creative thinking and personal initiative, rather than merely following orders from others (Lan, 2010). School-based curriculum is a new way of implementing the reform agenda, and consequently there is an increasing need for teacher learning and development in order to develop a teaching faculty capable of actively organizing student inquiry and active learning (Xu, 2002). The concept of "the ability to learn" is proposed as a key goal of education in lieu of the old concept of achievement of two basics as the main goal of basic education (Xu, 2010; Zhong, 2009). It is natural that inquiry-based learning has been proposed to support such high-end learning. A search conducted in August 2010 of the "China Academic Journals Web Publishing Inventory," using the keyword "inquiry-based learning," found 1 154 papers published since 2001, though most are theoretical or practical know-how papers rather than empirical studies. Based on an overview, inquiry-based learning in virtually all school subjects has been vigorously explored and investigated (e.g., Yan, 2009; Sun, 2010).

Though the top down reform has been implemented for years, the "buy-in" process for schools has not been easy. One of the main obstacles for the reform is

the high school, and later, college examination systems, which motivate schools, teachers, and parents to focus on preparation for entrance examinations (Wang, 2010). There is enormous pressure, individually and collectively, to perform well on these exams in order to get into better high schools and more prestigious colleges. Utilitarian purposes of schooling for academic competition overwhelm the fundamental purpose of education as empowering the person's mind and nurturing character. In some school districts, teachers' promotion depends on their ability to help students raise those high-stakes test scores. In this context, are teachers willing to adopt teaching approaches advocated by the reform movement? What are other practical constraints on education reform other than the school evaluation system?

Teachers are the main agent for change and pivotal for the success of any reform effort in school (Darling-Hammond & Bransford, 2006; Hu, 2010). Understanding teachers' perspectives becomes critical in a needs assessment, as they may encounter problems that challenge the practicality of the new pedagogy (Wu, 2009). Conceptually, we identify three factors as main determinants of teachers' attitudes toward the reform and their teaching practices: (a) Teachers' beliefs about the purposes of education and their values regarding what important characteristics their students should acquire as a result of their education. In order to teach in a different way, teachers have to believe that new teaching methods help students acquire desired characteristics. Ren (2002), for example, identified 18 beliefs about inquiry-based learning, 12 supporting the approach, and 6 against it. Liang, Qian, and Lu (2008) argued that inquiry-based learning cannot be effective without the support of traditional direct instruction, and vice versa. Based on their review of the theoretical and empirical literature on science teaching, a research group concluded that inquiry-based learning, though effective in it hypothesis generating/testing mode of teaching and learning, is not a panacea for all educational and instructional problems teachers face ("Theoritical Experimental Research on Inquiry-Based Learning in Science" Project, 2001). Teachers tend to use teaching methods that they believe will achieve desired learning outcomes. If they are skeptical about the goals and effectiveness of inquiry-based learning in achieving these goals, they are likely to adhere to the traditional direct teaching approach.

(b) What kinds of incentives or disincentives the school and social environments provide for particular ways of teaching. Even if teachers believe in the goals and effectiveness of inquiry-based learning, the educational system may not encourage its use because the priority of education may lie in what students know (prescribed content knowledge), rather than how students think (higher-order thinking skills). It can be argued, indeed, that direct teaching (coupled with drill and practice) is the most effective and efficient way of covering large amounts of information and getting students prepared for

answering correctly what they have just learned. Wang (2010) argued that, in order to shift emphasis from exams to student abilities, there is a need to rebuild the school culture that motivates administrators, teachers, and students in an entirely different direction, a culture that values a set of student qualities beyond basic knowledge and skills (see also Zhong, 2009).

(c) Capacity building necessary for implementing inquiry-based learning. Even if teachers believes in inquiry-based learning and the school system endorses this pedagogy, teachers still can encounter obstacles if they do not know how to effectively use this approach in their classroom and on the subjects they are teaching. Moreover, as inquiry-based learning is often quite demanding in terms of instructional and logistical resources (e.g., research sources, communication platforms, community connections), a school may be ready theoretically for inquiry-based learning but encounter enormous problems at a practical level. Efforts have been made in capacity building on many fronts, such as teacher training and development (Hu, 2010), use of technology such as the Blackboard system to support inquiry-based learning (Li & Shan, 2010). Yet we still do not know how well schools in general are prepared to meet the professional development needs of teachers, and build its infrastructure to support inquiry-based learning.

The purpose of this study, then, was to examine teacher beliefs, values, perceptions, and practices regarding the above three aspects in the context of making a transition from a didactic teaching to an inquiry method of teaching and learning called for by the education reform movement. Three research questions were asked for this study:

- Do teachers believe in inquiry-based learning and underlying principles?
- Do teachers practice inquiry-based learning?
- What do teachers perceive as practical constraints/obstacles of implementing inquiry-based learning?

Method

Instrumentation

We first developed a conceptual framework for item creation and selection. Table 1 shows the conceptual structure of the survey and item representations. Most of the items were created by the authors based on the conceptual framework, with the targeted Chinese teachers in mind. There were also a few items borrowed from a survey instrument “High School Survey of Student Engagement” developed by the Center for Evaluation and Education Policy at Indiana University (Yazzie-Mintz, 2007).

Table 1 Conceptual Structure and Item Representations of the Survey

A. *Beliefs and Values: Progressive* (using 4-poiny scale: 1. Strongly disagree 2. Disagree 3. Agree 4. Strongly agree)
a. Knowing is a "living experience" that is assisted through student reasoning about their experiences and observations. c. When students tackle real world problems in learning, they are better able to turn information into useful knowledge later on. e. Students' education should support their ability to see the interconnectedness of human knowledge. f. Students should be exposed to different views for comparison in order to develop their own views. i. It is important to encourage students to explore new ideas, even though they may sound far-fetched. l. The most effective way of instruction is to embed learning in meaningful inquiry into real world problems and issues.
B. *Beliefs and Values: Conservative* (using 4-poiny scale: 1. Strongly disagree 2. Disagree 3. Agree 4. Strongly agree)
b. Knowledge has its certainty and objectivity. What is wrong cannot be right. d. The main goal of teaching is to develop basic skills (e.g., reading and writing) and subject matter knowledge. The development of cooperation skills, communication skills, and leadership skills is important but is not the main goal of teaching. g. It is not realistic when teaching specific subjects to ask students to learn how to think like scientists (or mathematicians, literary critics, historians, or sociologists, etc.), as students are not equipped with the necessary knowledge to do so. h. It is not realistic to ask students to participate in making curricular decisions; teachers know better what students must learn and how to learn it. j. My instructional decisions are primarily driven by the content of the subject; student interests and abilities are secondary. k. For middle and high school students knowledge acquisition is the main goal of learning. Creativity and critical thinking are something they can develop when they reach adulthood (or complete higher education).
C. *Practicing Inquiry Pedagogy* ("How often do you do the following in teaching your subject(s)?" on 4-point scale: 1. Rarely 2. Sometimes 3. Often 4.Very often)
b. Allow students to share ideas and discuss and debate issues from diverse perspectives. c. Have students explain key ideas and concepts in their own words. d. Pose questions and challenge students to think rather than telling them correct answers and procedures. e. Challenge students to make judgments about the value of a piece of information, a way of expression, or the soundness of a specific conclusion. f. Ask students to explain their solutions to a problem. g. Offer group projects that help students achieve learning goals through collaboration. h. Offer independent study opportunity for individual students to pursue topics of their interest and strength. i. Require students to apply knowledge they have learned to new situations. j. Provide for active engagement of students in problem solving. k. Provide opportunities for students to engage in inquiry into issues relevant to them at a personal level. **a. Lecturing **l. Require students to memorize facts or ideas so they can learn them by heart

(*To be continued*)

(*Continued*)

D. *Practical Constraints* (using 4-point scale: 1. Strongly disagree 2. Disagree 3. Agree 4. Strongly agree)
Impractical
a. I was unaware that I was supposed to be doing these activities.
b. These ideas sound good, but are not efficient in reality for student learning.
c. I do not believe that these activities will lead to higher student performance.
d. I do not believe that these activities will lead to greater student creativity and innovation.
h. There is a lack of professional development for me to develop an awareness and understanding of these concepts.
i. I know these concepts well, but I am not sure how to actually apply them in my classroom.
Lack of Resources
e. Class size is too big for these activities.
f. The facilities in my school are not conductive to organizing these activities.
g. There is no time left for these activities, as I have to cover the curriculum, which takes much of class time.
j. The school lacks an infrastructure (technological platform, search tools, information resources, supporting personnel, etc.) that supports this kind of instructional activities.
Test Pressure
k. Parents would not support these activities dominating our curriculum.
m. Preparation for high-stakes tests makes these activities a lower priority.
n. Underlying ideas and goals of this approach are not valued in our educational system.
l. These open-ended activities are inefficient, as students can easily get lost or confused.

Note: * The two marked items represent "traditional pedagogy."

The survey was organized into three main sections: (a) teacher beliefs and values, (b) teaching practices, and (c) perceived practical constraints and obstacles. For "teacher beliefs and values," a wide range of beliefs were presented for teacher rating, some more "progressive," representing their readiness for the reform initiative, others more "conservative," representing their skepticism about the new movement and adherence to the traditional approach that stood the test of time. For "teaching practices," we also sampled a wide range of instructional methods, from lecture to open-ended class discussion, with a focus on methods purported to support inquiry-based learning. For "perceived practical constraints and obstacles," we sampled a variety of school and social environment factors that could impact teachers' ability to effectively support inquiry-based learning in their classrooms. For a preliminary survey like this, our strategy was to cast a net wide enough to capture important information rather than dealing with a narrowly defined issue in depth. While designing this instrument, we attempted to make it responsive to many concerns and issues expressed by Chinese educators. For example, the instrument fully incorporated six counter-arguments regarding inquiry-based learning (Ren, 2002), on theoretical (e.g., is inquiry-based learning necessarily superior to the traditional lecture/recitation method?) as well as practical grounds (e.g., lack of proper teacher development and school infrastructure).

A four-point rating scale (rarely, sometimes, often, very often) was used for "behavior" items (e.g., "Provide for active engagement in problem-solving"). A similar four-point rating scale but ranging from "strongly agree" (1) to "strongly disagree" (4) was used for "belief" items (e.g., "Students should be exposed to different views in order to develop their own"), as well as practical constraint items.

Besides ratings, there are two open-ended questions asking respondents to

- list additional reasons for difficulty in implementing inquiry-based changes;
- identify reasons for willingness to implement inquiry-based pedagogical changes (see Appendix for English and Chinese versions of the survey).

Sampling Procedures

We were trying to obtain a sample that was representative of schools in highly developed as well as less developed regions in China. Therefore, both central cities such as Shanghai and Beijing and geographically and economically diverse provinces such as Hebei, Fujian, Hainan were targeted. As a result, 16 cities, and 9 provinces were represented in this survey. We first approached school administrators for permission to recruit their teachers for the survey, and then the teachers either filled out the paper survey or completed the survey on-line on an anonymous basis. A total of 696 completed questionnaires were obtained. We examined all questionnaires for authenticity and found out that 77 respondents were apparently copying colleagues' responses because their responses were identical to one of their colleagues; 37 responded to the survey in a non-discriminative fashion, giving identical responses (e.g., all 3s or all 4s) to all items. To ensure the validity of the survey, these 114 questionnaires were removed, resulting in 582 valid completed questionnaires. The gender composition is 36 % male and 64 % female. Of the 582 teachers, 56 % from middle schools, and 43 % from high schools, 45.6 % from urban, 48.7 % from suburban, and 5.7 % from rural areas, 20.7 % from "key" schools, and 79.3 % from "ordinary" schools. For comparison purposes, we also collected a small sample of middle and high school teachers[1] (n = 39) from New York State.

Results

Because the researchers did not have control over many factors that can influence the quality and authenticity of such a survey, we decided to take a more

[1] In this paper, middle schools refer to lower secondary (junior high) schools and high schools to upper secondary (senior high) ones.

"diagnostic" approach to data analysis and interpretation, treating the data more cautiously in regard to (a) how serious was the respondent, (b) what were the "pragmatic meanings" rather than "literary meanings" of particular responses, (c) were respondents responding differently when the self-report concerns one's own attitudes or behavior versus others' (Schwarz, 1999), and (d) how cultural factors might affect respondents' behavior when a survey like this one *de facto* asked whether they endorsed the education reform.

We first looked at response patterns in order to detect potential social desirability bias. When asked whether inquiry-based learning is viable, 64 % gave a lukewarm "somewhat viable," and only 34 % responded "quite viable" or "highly viable." Yet, when asked to what extent they endorse and actively support this approach, the response pattern reversed, with 75 % selecting "highly committed" or "committed," and only 25 % selecting "a little bit committed" or "not committed." This suggests a possible bias of the respondents in portraying themselves more favorably even when they expressed a less optimistic view of the new pedagogy. To double check the authenticity of these responses, we compared those (n = 189) who responded to the two open-ended questions and those (n = 393) who skipped them entirely. We surmised that the former should be more genuinely concerned with the reform efforts, given their willingness to take extra time to address these open-ended questions. The results show a similar pattern of responses to these two items. Thus we could not exclude the possibility that this pattern of biased responses reflect a true ambulant attitude toward reform rather than merely a social desirability bias.

To ensure the validity of our interpretation, we triangulated quantitative data with qualitative data (responses to open-ended responses). We also attempted to situate meanings of responses in specific educational and social contexts. In that sense, we were trying to approach this quantitative survey "qualitatively."

Endorsement of Inquiry-Based Learning: Beliefs versus Behaviors

We aggregated ratings on all statements of inquiry-based learning principles (n = 6) and labeled it "progressive" (see Table 1). We obtained a mean score of 3.11 and standard deviation of 0.41, indicating that most responses were positive, endorsing the inquiry learning principles. When asked to identify reasons for willingness to implement inquiry-based pedagogical changes (open-ended questions), 23 respondents mentioned student "interest" and "motivation" as a main reason, 18 mentioned advantages related to skills transfer, or long-term gains and benefits for students, 8 respondents identified students' "personal initiative" and "self-direction" as a main benefit. These comments indicate authentic beliefs in the benefits of inquiry-based learning for self-direction and personal growth. When it comes to how often they practiced inquiry-based

pedagogy, we obtained a mean score of 2.61 for the composite measure, with a standard deviation of 0.47 (see Table 2). The discrepancy of about a half point between the "beliefs" measure and the "practices" measure (3.11 vs. 2.61) suggests the existence of distance or obstacles from theoretical endorsement to practicing the endorsed pedagogy.

Table 2 Intercorrelations of Six Dimensions

	1	2	3	4	5	6
1. Progressive	0.73					
2. Conservative	0.04	0.66				
3. Inquiry pedagogy	0.38**	0.07	0.84			
4. Impractical	–0.20**	0.34**	–0.21**	0.72		
5. Test pressure	0.07	0.17**	–0.14**	0.41**	0.67	
6. Lack resources	0.04	0.14**	–0.19**	0.52**	0.48**	0.71
Mean	3.11	2.47	2.61	2.28	2.54	2.52
SD	0.41	0.44	0.47	0.42	0.58	0.52

Note: On the diagonal are alpha reliabilities.

To better understand differences in teacher beliefs and values, we ran a factor analysis of the "beliefs and values" items. The result suggests two distinct factors. We aggregated items and labeled them "progressive" and "conservative." As shown, "progressive" items are in line with the reform initiative, and the "conservative" items reflect beliefs of traditionalists who hold fast to the teacher-centered, knowledge transmission model of learning regarding the means and ends of teaching. These items were deliberated built to balance out potential response biases (Schwarz, 1999), as well as represent diverse opinions regarding inquiry-based or more constructivist-oriented pedagogy in China (Ren, 2002). The results show that the Chinese teachers' responses to the "conservative" measure were more mixed than their responses to "progressive items," with equal numbers of responses on both "agree" and "disagree" sides. Moreover, there was no correlation between the "conservative" and "progressive" dimensions (r = 0.04, ns.), suggesting that many respondents endorsed both "conservative" and "progressive" categories of statements rather than see them as antithetical to each other. This tendency to take an eclectic or ambivalent position becomes more distinct when we compared the Chinese teachers' responses with those of a comparable American sample we collected (n = 39). For example, for the item "It is not realistic to ask students to participate in making curricular decisions; teachers know better what students must learn and how to learn it," 85 % of the American respondents disagreed, but only 48 % of the Chinese respondents

disagreed. When practicing inquiry-based learning is concerned, distinct differences can also be found. For example, for the item "Allow students to share ideas and discuss and debate issues from diverse perspectives," 80 % of the American teachers responded "often" or "very often," but only 54 % of the Chinese teachers did so. The difference could be larger if we take into consideration the factor that the social desirability bias could be more distinct for the Chinese teachers in the context of top-down reform mandate that calls for active student participation; for American teachers, examining ideas and debating issues is arguably the norm of classroom teaching and part of the general culture.

Our second question was to what extent do Chinese teachers practice inquiry-based pedagogy? We first look at how often they use the lecture and recitation format of teaching. As expected, 92 % of the respondents said they lectured "often" or "very often," and 82 % said they "often" or "very often" require students to "learn by heart" facts and ideas, a learning method used for thousands of years in China. In comparison, the respective numbers for the American sample were 29 % and 37 %. We can infer that if the time-honored lecture-recitation method works well in Chinese classrooms, particularly with respect to raising test scores, there will be reluctance to adopt more open-ended, learner-centered approaches, which are presumably more time-consuming and more difficult to organize and manage.

In sum, Chinese teachers are apparently receptive to inquiry-based learning and aware of the underlying principles and theories regarding the means and ends of education and what they expect students to acquire as a result of their education. However, their priorities and familiarity with the traditional lecture-recitation method may lead to mixed feelings about the new pedagogy. As a result, many of them may not feel compelled to try the new approach. The results we present above suggest that beliefs and values could stand in the way of reform.

Perceived Practical Constraints

The third question we asked was to what extent practical constraints and obstacles are the main reason for practicing inquiry-based learning. Practical constraints have to do with two major questions teachers have: Does inquiry-based learning serve our educational priorities well? Can we successfully implement and carry out inquiry-based learning? These questions concern whether the school and social environments provide incentives or disincentives for inquiry-based pedagogy, and whether inquiry-based pedagogy is supported by capacity building initiatives, such as professional development and development of school infrastructure, in support of the new pedagogy. The following were identified practical constraints in the order of percentages of respondents saying

"agree" or "strongly agree": pressure for high-stakes tests (69 %), content coverage (52 %), class size (49 %), professional development (49 %), facility/resources and supporting infrastructure (46 %), and parent and culture (45 %). In comparison, the American teachers we surveyed selected infrastructure (45 %), lack of professional development (42 %), facility not conducive to inquiry learning (36 %), and high-stakes testing (34 %) as practical constraints. Apparently, the exam-driven education system in China was perceived as the main obstacle for the implementation of the new pedagogy. When asked to list additional reasons for difficulty in implementing inquiry-based changes (i.e., the open-ended question), 38 Chinese teachers mentioned "lack of abilities, knowledge, good learning habits in students" as an obstacle, which was not covered in our survey items; 26 mentioned the test pressure and the evaluation system, particularly the college entrance exam, and 18 mentioned "class size," "content coverage," and "limited time/control" as obstacles, which correspond well to responses to the relevant rating items. Taken together, practical concerns expressed by the teachers we surveyed were quite prevalent regardless of whether one theoretically endorses the inquiry pedagogy, in terms of both incentives/disincentives and capacity constraints. While teachers from both nations mentioned pressure from high-stakes testing, lack of professional development, and lack of infrastructure building as obstacles, Chinese teachers particularly highlighted class size and expectations held by parent and culture as impediments to the new pedagogy.

Individual and Group Variations

We examined potential variations of responses as a result of years of teaching and subjects taught. We found no effect of years of teaching, no effect of subjects taught, between math/science (M/S) versus language arts/social studies (LA/SS) teachers, except that M/S teachers reportedly used more "recitation," requiring students to learn by heart, than LA/SS teachers (2.77 vs. 2.32).

We also examined whether middle and high schools differed, and whether key (selective) schools and ordinary schools differed. The results show that high school teachers reported more test pressure than middle school teachers, understandably so because of the imminent college entrance exams. Key school teachers reported more positive attitude toward inquiry-based learning than ordinary school teachers, and ordinary school teachers perceived more need for developing infrastructure for inquiry-based learning. Together, they suggest that key schools may emphasize higher-order thinking more, and have more resources to work with in support of the inquiry-based curriculum, hence a higher interest in inquiry-based learning activities.

Teacher Comments

Some teachers made elaborate comments. These comments provide a more detailed glimpse of how they implemented inquiry learning and what issues they encountered. A middle school chemistry teacher mainly complaint about the test-driven school environment as impediment to inquiry-based learning: "… [T]he evaluation system is unscientific (purely based on test scores); the learning materials are too difficult and too much for students, leading to overburdened students." A middle school history teacher also blamed the test-driven education system: "But…the time allowed for inquiry is not sufficient. Even if we have enough time, students tend to focus their attention on raising test scores, ignoring the process of inquiry and giving more attention to memorizing facts. Besides, student knowledge is limited and sometimes inquiry remains superficial and lacking in depth. Now, the entrance exam is a commanding force that turns the attention of parents, school, teachers, and students to test scores and away from developing abilities and skills. Passive learning still dominates." As mentioned earlier, many teachers were concerned about their students' ability to handle the challenges involved and benefit from the new pedagogy. One rural middle school teacher language arts teacher saw the overall low academic achievement as a main obstacle to implementing inquiry-based learning:

> Our students have a low-level achievement (less than 20 % passed). We have a total of over 1600 students, about 400 9th graders, who have developed a passive learning style by now, and it is difficult for them to change, and it takes time. Even though individual teachers may be appreciative of this approach, it is hard to create a climate in classroom for effective reform; there is a lack of guidance and support from the administrators, which renders reform efforts fruitless.

It appears that concerns over resources and support, as well as worries about students' ability to carry out inquiry and benefit from it, overwhelm theoretical concerns such as whether inquiry-based learning could promote higher-order thinking and develop better learners.

Discussion

Teachers as main stakeholders of the education reform movement play a pivotal role in implementing the reform initiative in classroom. They also bear the brunt of many pressures from administrators and parents to raise test scores and enhance their students' chance to go to better high schools or colleges. Besides pressures from high-stakes testing, there are other theoretical and practical issues to be addressed to make a compelling case for the reform initiative. These issues

set the stage for this survey. It should be quickly pointed out that the study represented a preliminary effort to understand Chinese teachers' perspectives on inquiry-based learning in the larger context of education reform in China, and our interpretation of the results is a highly tentative one, given the nature of a survey like this; it is not inconceivable that misinterpretations can happen because of the experiential and perspectival differences.

A central question in this survey is: Do Chinese teachers theoretically endorse inquiry-based learning, and if so do they practice the inquiry pedagogy? The data show that Chinese teachers seem to endorse the progressive education agenda and inquiry pedagogy while at the same time split in the middle about the main goals of education and traditional teacher-centered, didactical pedagogy. It was probable that the "progressive" items were too compelling to disagree with, but the "conservative" items sound more realistic to Chinese teachers. The data suggests that that skeptics and enthused supporters of new initiative for curricular and pedagogical reforms are evenly distributed, with many on the fence. For example, for the 114 teachers who copied or otherwise did not find the survey meaningful enough to give some time and thought, the reform movement may be another round of government initiatives that comes and goes, and would have no real impact. Going through the movement is likely their answer, a form of passive resistance. We also witnessed many teachers who left messages at the end of their questionnaires expressing their enthusiasm for the inquiry pedagogy as well as their frustrations in implementing this approach. More specific to the inquiry-based, or broadly defined constructivist, mode of instruction, it is not surprising that teachers have mixed and ambivalent feelings. The issue of whether higher order thinking skills or foundational knowledge should be the main goal of education, and whether the constructivist pedagogy can effectively facilitate student knowledge construction is also debated among educational scholars and researchers in both countries (e.g., Ren, 2010; Liang, Qian, & Lu, 2008; Tobias & Duffy, 2009). Nevertheless, we sense a general feeling that inquiry-based learning is theoretically sound but practically difficult to implement in current educational and social contexts in China. If this is the case, we might even consider the reported frequencies of using various inquiry methods by the Chinese teachers to be inflated due to social desirability bias.

The most obvious difficulty that Chinese teachers encountered in implementing inquiry-based learning was the performance pressure imposed by the high-stakes entrance exams. This conjecture is confirmed by this study, as test pressure was most frequently identified by Chinese teachers, both in item ratings and open-ended responses, as a major practical constraint on inquiry-based learning. If all the incentives and resources go with raising test scores, inquiry-based learning clearly will not win out, as it is time-consuming and typically does not produce immediate, tangible results that parents or

education officials would appreciate for "accountability" purposes. Indeed, the lecture-recitation method is typically more efficient in committing large amounts of information (facts, procedures, and theories) to memory. Unless the evaluation system provides incentives for promoting higher-order thinking skills beyond the information given, the instructional change in the direction of inquiry-based pedagogy will not be sustainable. What is needed is a value system that appreciates and understands the value of education at a much deeper level and on a much broader scope than merely getting good test scores or sending children to more selective and prestigious schools. In that sense, it entails a change in school culture (Wang, 2010), and beyond.

Besides the test pressure that sets priorities that are at odds with inquiry-based learning, the results of this survey also support the argument that in order to effectively implement inquiry-based learning, there is an urgent need for capacity building. They include, among others, professional development and infrastructure building. Without capacity building, none of the educational ideals can be realized. This can only be accomplished with institutional leadership. We strongly recommend that teachers should be give opportunities for professional development that not only prepare teachers theoretically for the reform but also develop their practical skills in implementing the inquiry pedagogy. We also recommend that school leaders pay attention to infrastructure building. It may include providing special personnel and technological support, such as creating an internet-based platform for teacher-student communication and resource sharing. Inquiry-based learning also tends to use multiple resources in and outside of school that require special attention and investment.

Beyond the boundary of school, inquiry-based learning is culturally highlighted in a society that values individuality, inquisitive minds, and intellectual independence, including the belief that educators should ultimately "let go" so that our students can be "on their own." How much we can entrust students to "own" their own learning is a central concern. Unexpectedly, in response to the open-ended question regarding additional concerns for and obstacles to the inquiry pedagogy, a large number of Chinese teachers were concerned about students' lack of knowledge and ability to handle the learning tasks without explicit teaching. None of the 39 American teachers we surveyed raised this concern in their responses to this question. There seems to be a sense of insecurity among the Chinese teachers in handling the uncertainties resulting from a more "open-ended" approach to teaching. The worry that "Will my students stumble if I let go?" seems to mirror the attitude of Chinese parents toward their children as if they have to lead their children every step of the way. Inquiry-based pedagogy dictates that we not only encourage student participation, but also grant them "authority" to carry out inquiry into important matters (Engle, in press).

On a final note, we argue that inquiry-based learning is deeply rooted in educational philosophy (Dewey, 1933). If inquiry-based pedagogy is only seen as a teaching technique, we will miss Dewey's main point about the function of education as cultivating minds capable of independent, critical thinking and making well reasoned arguments and decisions about social affairs and one's own personal life. How much value teachers, school administrators, and parents place on this aspect of inquiry-based learning may ultimately determine how viable and sustainable the education reform movement will be in China.

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References

Aulls, M. W., & Shore, B. M. (2008). *Inquiry in education: The conceptual foundations for research as a curricular imperative*. New York: Erlbaum.

Bransford, J. D., Brown, A., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Bransford, J. D., Sherwood, R., Vye, N., & Rieser, J. (1986). Teaching thinking and problem solving. *American Psychologist*, *41*, 1078–1089.

Brown, A. L., & Campione, J. (1994). Guided discovery in a community of learners. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and classroom practice* (pp. 229–270). Cambridge, MA: The MIT Press.

Bruner, J. (1979). *On knowing: Essays for the left hand*. Cambridge, MA: Belknap Press of Harvard University Press.

Darling-Hammond, L., & Bransford, J. (Eds.). (2005). *Preparing teachers for a changing world: What teachers should learn and be able to do*. San Francisco: Jossey-Bass.

Dewey, J. (1933). The process and product of reflective activity: Psychological process and logical forms. In J. Boydston (Ed.), *The later works of John Dewey* (Vol. 8, pp. 171–186). Carbondale, IL: Southern Illinois University Press.

Dewey, J. (1997). *How we think*. New York: Dover Publications, Inc. (original published in 1910 by D. C. Heath Co., Publishers, Boston).

Duschl, R. A., & Duncan, R. G. (2009). Beyond the fringe: Building and evaluating scientific knowledge systems. In S. Tobias, & T. M. Duffy (Eds.), *Constructivist instruction: Success or failure*? (pp. 311–332). New York: Routledge.

Duschl, R., & Grandy, R. (Eds.). (2008). *Teaching scientific inquiry: Recommendations for research and implementation*. Rotterdam, Netherlands: Sense Publishers.

Engle, R. A. (in press). The Productive Disciplinary Engagement framework: Origins, key concepts, and developments. In D. Y. Dai (Ed.), *Design research on learning and thinking in educational settings: Enhancing intellectual growth and functioning*. New York: Routledge.

Engle, R. A., & Conant, F. C. (2002). Guiding principles for fostering productive disciplinary engagement: Explaining an emergent argument in a community of learners classroom. *Cognition and Instruction*, *20*, 399–483.

Hatano, G. (1988). Social and motivational basis for mathematical understanding. In G. B. Sax,

& M. Gearhart (Eds.), *Children's mathematics: New directions for child development, No. 41* (pp. 51–70). San Francisco: Jossey-Bass.

Hu, J. P. (2010). 教师应成为"源头活水" [Teachers should become a source of inspiration]. 当代教育论坛(教学版) [*Forum on Contemporary Education*], (1), 23.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, *41*, 75–86.

Lan, X. M. (2010). 从创新能力培养层面讨论中国教育改革 [On education reform from the perspective of nurturing creativity]. 南昌教育学院学报 [*Journal of Nanchang College of Education*], *25*(1), 1–2.

Langer, J. A. (in press). The Interplay of creative and critical thinking in instruction. In D. Y. Dai (Ed.), *Design research on learning and thinking in educational settings: Enhancing intellectual growth and functioning*. New York: Routledge.

Li, W., & Shan, Z. (2010). Blackboard 网络教学平台下"探究式学习"的研究与实践 [Research and practice on inquiry-based learning in the context of the teaching platform of the Blackboard network]. 计算机教育 [*Computer Education*], (1).

Li, X. G. (2009). 浅析语文阅读教学中探究式学习的组织实施 [A preliminary analysis of organization of inquiry-based learning in teaching language arts]. 新课程研究(基础教育) [New Curriculum Research (Basic Education), (6), 67–68.

Liang, Y. F., Qian, Z., & Lu, F. L. (2008). 试论探究式学习与接受式学习的辩证关系 [On the dialectical relationship between inquiry-based learning and receptive learning]. 当代教育论坛(学科教育研究) [*Forum on Contemporary Education (Disciplinary Education Research*), (3).

Ministry of Education. (2001). 基础教育课程改革纲要(试行) [*Guidelines for curriculum reform in basic education (Trial)*].

Perkins, D. N. (1995). *Outsmarting IQ: The emerging science of learnable intelligence*. New York: Free Press.

Ren, C. S. (2002). 对探究式学习的 18 种评论——支持探究式学习的 12 条评论和反对探究式学习的 6 条评论 [Eighteen propositions regarding inquiry-based learning: 12 for and 6 against the pedagogy]. 华东师范大学学报(教育科学版) [*Journal of East China Normal University* (*Education Science Edition*), (4).

Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. In K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 97–118). New York, NY: Cambridge University Press.

Schwarz, N. (1999). Self-reports: How the questions shape the answers. *American Psychologist*, *54*, 93–105.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–22.

Sun, H. S. (2010). 如何在数学课堂教学中开展探究式学习 [How to carry out inquiry-based learning in mathematics teaching]. 新课程研究(基础教育) [*New Curriculum Research (Basic Education)*], (3), 104–105.

"Theoritical and Experimental Research on Inquiry-Based Learning in Science" Project (2001). 探究式学习:含义、特征及核心要素 [Inquiry-based learning: Meaning, characteristics, and core elements]. 教育研究 [*Educational Research*], (12).

Wang, J. (2010). 从"应试教育校园文化"到"素质教育文化校园"—论当前学校文化的特点与转型 [From the test-preparation school culture to a quality education school culture: On characteristics of the current school culture and its transition]. 教育理论与实践 [*Education Theory and Practice*], (7), 18–21.

Whitehead, A. N. (1957). *Aims of education and other essays*. New York: The Macmillan Company.

Wu, L. P. (2009). 探究式教学实验方案设计中的问题及解决策略 [Problems and solution strategies for planning experimentation in inquiry-based learning]. 读与写杂志 [*Read and Write Periodical*], (4), 190–191.

Xu, P. (2010). 以学力培养为核心的基础教育改革初探 [On basic education reform with nurturing the ability to learn as its core]. 现代教育科学 [*Modern Education Science*], (4), 49–51.

Xu, X. H. (2002). 校本培训的探索与实践——点击青岛新世纪学校教师培训活动 [Explorations and practices in school-based curriculum: Teacher training activities in Qingdao New Century School]. 继续教育 [*Continuing Education*], (2), 29–30.

Yan, D. F. (2009). 也谈化学教学中的探究式学习法 [Also on inquiry-based learning in chemistry teaching]. 新课程研究(基础教育) [*New Curriculum Research (Basic Education)*], (6), 87–88.

Yazzie-Mintz, E. (2007). *Voices of students on engagement: A report on the 2006 High School Survey of Student Engagement*. Bloomington, IN: Center for Evaluation and Education Policy, Indiana University.

Zhang, J. (in press). Designing adaptive collaboration structures for advancing communal knowledge. In D. Y. Dai (Ed.), *Design research on learning and thinking in educational settings: Enhancing intellectual growth and functioning*. New York: Routledge.

Zhang, J., Scardamalia, M., Reeve, R., & Messina, R. (2009). Designs for collective cognitive responsibility in knowledge building communities. *Journal of the Learning Sciences*, *18*, 7–44.

Zhong, Q. Q. (2009). 从日本的“学力”概念看我国学力研究的课题 [On the ability to learn in China from the Japanese notion of the ability of learn]. 教育发展研究 [*Research in Educational Development*], (2), 1–5.