



Full length article

Qualitative investigation on the views of inquiry teaching based upon the cloud learning environment of high school physics teachers from Beijing, Taipei, and Chicago

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ABSTRACT

The teachers' understanding or conceptual beliefs would reflect their basic views on education, the nature of the course, their students, and how learning should be conducted. Once formed, such views would remain relatively stable for a significant period of time and affect their teaching practice, the ability of their students to carry out inquiry learning as well as developments in corresponding techniques and mindsets. This research analyzed the differences in the level of understanding of inquiry teaching under the cloud learning environment (CLE) between high school physics teachers from Beijing, Taipei and Chicago. As part of the analysis, video recordings of four actual high school investigative physics course sessions were selected from the 4th Competition of Middle School Physics Teachers Instruction Skills held in 2014 and ranked by the high school physics teachers from the three different cities in terms of inquisitiveness of the course. Results revealed significant differences exist between teachers from the three different cities in terms of understanding of CLE-based inquiry teaching. Teachers from Chicago inclined towards the students' awareness of the problem as well as their ability to collect and question data. Teachers from Beijing, on the other hand, prioritized a procedural approach in inquiry and investigations for their students. Finally, teachers from Taipei shared characteristics from both cities. In essence, teachers from Beijing were more teacher-focused in their understanding of inquiry teaching, while teachers from Chicago were more student-focused. Teachers from Taipei, on the other hand, was somewhere in between.

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1. Introduction

No other viewpoint in the field of basic science education has been subject to more widespread and global attention than *scientific inquiry* or *inquiry teaching*. If the objective of science educators for the past century must be described in a single word, then this word would be *Inquiry*. Basic science education with *scientific inquiry as the core* has become a global consensus. Reforms in national science education programs have focused on promoting inquiry teaching and learning (NRC, 2000). The objective is to use actual scenarios to investigate scientific processes and develop scientific knowledge and skills, understand the nature of science,

and help students acquire the necessary scientific discipline (Miller, 1998). The essence of scientific inquiry has also been subject to constant changes, which led to changes to the value and direction of science education. Science education in China has been searching for a paradigm shift as well. Given that inquiry teaching is the objective of science education in China, efforts would inevitably push educational developments towards that direction.

Countries around the world now regard scientific inquiry and inquiry teaching as the objective and methodology for science education. The National Science Education Standard (NSES) stipulated by the National Research Council of the US (NRC) clearly pointed out that scientific inquiry is the most fundamental and governing principle of scientific learning, serves as the core of science education, and would be the most effective method for improving the scientific discipline of the general public. In order to promote student learning of the sciences, teachers must encourage students to develop the mindset, habit, curiosity, interest, and

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creativity of a scientist to focus their learning upon the process of inquiry (NRC, 1996). Recent educational reforms in Taiwan also gradually shifted from its original system-based approach to enact changes to the actual teaching process. The most cited reform was the *National Education Series Continuous Nine-Years Education Program Curriculum Summary* released in 1998 by the Ministry of Education. This proposal raised the necessity to have students learn how to apply technology and data, take the initiative in discovering and researching knowledge, and develop independent thinking and problem solving skills with particular emphasis upon the functions of scientific inquiry in basic science education. Mainland China started introducing and promoting the theories and mindsets of inquiry teaching during the 1970s and initiated large-scale reforms during the 1990s. The country's *Science Curriculum Standard* prioritized scientific inquiry as the main objective of science education, with the *National Curriculum Reform Outline of Basic Education* (under trials) clearly pointing out the need for educational processes to nurture the students' independence and proactiveness as well as to encourage questioning, investigation, and discovery. Curriculum standards of various science subjects issued by the Ministry of Education also required the development of inquiry-based teaching.

China has currently initiated a new wave of reforms for its basic education curriculum, targeting scientific inquiry as a game changing solution with the aim of revolutionizing traditional student learning models characterized by passive acceptance and acquisition of knowledge. These reforms encourage inquiry-based learning that feature active student participation, practical sessions that strengthen student understanding of the process of scientific research, discovery, and innovation while developing skills needed for integrating and applying various aspects of knowledge. These new and revised courses have focused upon scientific inquiry without compromising basic knowledge or techniques which would be employed as the basis for developing higher order thinking abilities to make students better prepared in knowledge discovery and problem solving (Wang, Guo, & Jou, 2015).

Science educators around the world have already reached a consensus with regards to the necessity of science education in helping students understand the nature of scientific inquiry and developing the students' inquiry skills. However, different perspectives exist on the importance of inquiry skills in science courses as well as the means to achieve the desired objectives (Cheung & Ng, 2000). These different perspectives can be largely summarized into two major groups. The first believes that course objectives can be achieved through gradual influence, where students observe demonstrations and personally experience inquiry-based experiments. The second perspective believes that the ideas of the scientific method must be clarified and promoted among the students, and even considers student understanding of the scientific method or process to be more important than the actual scientific knowledge itself. In terms of developments and designs of science courses, the second perspective gained wider support amongst scientific educators (Lederman, 2007). Achieving the beliefs of the second perspective thus became a challenge in the field of science education.

Teachers are bridges that link learners to the course contents. Student learning models can only be changed through courses, and these courses can only be taught or remodeled by the teachers and their teaching activities. Hence, teachers play an important role for achieving the objectives of scientific inquiry. A common issue encountered in science education is that while some teachers are willing to be part of the reforms of science education, others continue to adhere to the traditional approach. It is thus important to understand the reasons why teachers would prefer the older method. Large amounts of research conducted in China and the rest

of the world identified teachers' understanding, perspective, and belief as the root cause of the problem. The teachers' understanding or perspectives reflect their basic views on education, the nature of the course, the students, and learning as a whole. Once these basic views have been established, they would remain more or less static for extended periods of time. The teachers' understanding, beliefs, and values form the basis of the teaching methods adopted while influencing student-teacher interaction as well as student learning and character development. Scientific inquiry would need to be taught separately for teachers who only focus on the pursuit of scientific knowledge and ignore the aspect of scientific inquiry, experiments and practical activities (Gallagher, 1991). In summary, the teachers' understanding of inquiry teaching would affect their teaching practice, the ability of their students to carry out inquiry learning as well as developments in the students' corresponding techniques and mindsets.

Technological advancements in mobile computing and wireless communication as well as growing popularity of smart, mobile end-user devices meant that the new approach of mobile learning has become a leading research topic for science education. Mobile learning provides a set of advantages which include mobility, great convenience, and personalized contents for the learners. To effectively enhance the outcomes of mobile learning, many researchers have decided to provide mobile learning resources through cloud computing. Cloud computing offers many solutions to problems inherent in mobile learning resources. For example, cloud services improve user learning efficiency and facilitate peer collaboration. Users are also offered seamless access to information anytime and anywhere through any digital device (<http://www.sciencedirect.com/science/article/pii/S0747563213004561> Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011). Cloud Learning Environments (CLEs) are gradually gaining ground over traditional Learning Management Systems (LMS) as CLEs facilitate both single-user or multi-user collaborative study modes. CLEs could also offer user-customized contents and courses from different sources that may include Open Educational Resources (Mikroyannidis, 2012). Since cloud computing offers data access with anyone, anywhere, and at any time, it provides a potential solution that enables instructors and students to conduct formal lessons even without a standard indoor classroom (<http://www.sciencedirect.com/science/article/pii/S0747563213004561> Astrid, Paul, Carol, & Jordana, 2012). Currently, CLEs have become more popular for the science curriculum, especially for the inquiry teaching model. The teachers' views of inquiry teaching could also be more effectively applied in actual teaching practice through the CLEs as well.

2. Literature review

Teachers' practice of inquiry teaching would be based on their own understanding of scientific inquiry (Kraus, 2008), and numerous linkages exist between the teachers' understanding and their actual practice (Lederman, 2007). This relationship would be similar to the one between the teachers' understanding of scientific nature and the dynamics of teaching practice. The same conclusion has also been reached in many classical investigations carried out in the field of basic science education around the world during the last century. Roth (Roth, 1984) discovered three different processes for the understanding of inquiry teaching in his study of 12 junior high school teachers in the subject of biology, namely acquisition through actual events, transformation of concepts, and achieving understanding of the material. Smith (Smith & Neale, 1989), on the other hand, divided the process into four categories, namely discovery, process, lecturing or mastery of the contents, and conceptual transformation. Other researchers have similarly divided the teachers' understanding of inquiry teaching into traditional,

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