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The influence of teaching methods on creative problem finding

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ABSTRACT

Problem finding is an important component of creativity, but research on it does not offer much guidance to teaching. The present research takes a step in that direction with two investigations. The first was a between-subjects evaluation of a short-term classroom teaching process, using creative Chinese problem finding (CCPF) to assess the impact. The second was a long–term, mixed-design of creative scientific problem finding (CSPF) as it developed in response to teaching that emphasized problem finding. Results showed that there were improvements, but different teaching methods had varied impact on students' creative problem finding (CPF) performance. A mixed teaching method that included both lecture- and inquiry-based teaching was superior to the lecture-based or inquiry-based methods when used separately. The mixed teaching showed the strongest improvements in students' flexibility and originality on the problem finding tasks. Finally, there was a significant interaction between teaching methods and instructional type (opened, closed) in flexibility and originality of CPF. Practical implications and limitations are discussed.

The strength of the Chinese educational system is probably that it provides students with factual knowledge. The weakness is no doubt that it does little to teach students to think. Yuan (1999), who was previously the Deputy Director of the Normal Education Department of Ministry of Education, said that the educational evaluation system of China was disabling students from having questions and was attempting to insure that students master everything. Education is very different in Western cultures, including America (Kim, 2005; Kumar, Daniel, Doig, & Agamanolis, 1998; Ng, 2003; Walczyk, Griffith-Ross, Tobacyk, & Walczyk, 2006). There is more emphasis on asking questions, independent thought, and creative problem solving.

Problem finding is an important component of creativity (Chand & Runco, 1993; Hu, Shi, Han, Wang, & Adey, 2010; Wakefield, 1985) and has received a great deal of attention in psychology and education. Definitions of *problem finding* vary. It is sometimes viewed as a kind of cognitive strategy and tied to effective learning (Graesse, 1992; Torres, 1998), but is also viewed as reflection of cognitive development (Kelley & Sigel, 1986). In the present study, problem finding was defined as a thinking activity that utilizes existing contexts and experience to produce and express new questions. It is cognitive, meta-cognitive, and even affective.

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In order to enhance the development of students' problem finding skills, attention must be directed not only to the quantity of problems posed, but also problem diversity (Yoshioka et al., 2005), problem quality (Kalady, Elikkottil, & Das, 2010), and the creative process (Hu, Adey, Shen, & Lin, 2004; Hu et al., 2010; Paletz & Peng, 2009). School experiences can influence problem finding as well, such as teaching methods, teachers' knowledge, teachers' attitudes towards questions, the classroom atmosphere, the evaluation system used and so on (Han, Hu, & Zou, 2005).

Teaching methods may play the most important role in promoting students' creativity (Hu, 2010). In traditional lecture-based teaching (LBT) there is usually a curriculum of disciplinization where each subject had relatively fixed structure and sequence, and a standard text book are used (Jayawickramarajah, 1996; Phil, 2000). The aim of LBT is to expose all students to identical knowledge (Finch, 1999). Teachers using such curricula are there to provide learning objectives and assignments, lectures (Albanese & Mitchell, 1993; Cariaga-Lo, Richards, Hollingsworth, & Camp, 1996; Enarson & Cariaga-Lo, 2001). Lecturing remains a crucial component in virtually all models of teaching methods, including problem-based teaching (Daine, Beverly & Barbara, 1989; Kusum et al., 1998). LBT is advantageous for students who have low levels of self-awareness (Cariaga-Lo et al., 1996), because frequent examinations provide regular feedback, which can compensate for low self-awareness.

Yet there are concerns about LBT. Knowledge may be blindly memorized, and thus transfer and generalization is difficult. When students encounter new problems they are unable to adapt what they have learned, they are not flexible and will tend to rely on inappropriate strategies or rote knowledge. Students often complain that some teachers dislike questions regarding the topic being taught (Abdul-Ghaffar, Ken, & Usha, 1999; Diaz & Cartnal, 1999; Guilbert, 1998; McCrorie, 2001; Remmen et al., 1998; Ronchetto, Budkles, TBarath, & Perry, 1992). Also problematic is the fact that LBT may not take the varied learners' perspectives into account. The LBT conveys information and content while lacking sufficient development of critical thinking skills and problem solving (Stetzik, Deeter, Parker, & Yukech, 2015).

Not surprisingly, Inquiry-based teaching (IBT) has become more and more popular. IBT focuses on students' critical thinking, hands-on ability, and problem solving ability (Kitot, Ahmad, & Seman, 2010). NRC describes inquiry as 'a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; . . .; and communicating results' (Alake-Tuenter et al., 2012; NRC, 1996, p.23). Inquiry teaching is defined as a pedagogical method combining higher order questioning with student-centered discussion and discovery of central concepts through laboratory activities (Damnjanovic, 1999; NRC, 1996). Some aspects of inquiry are individual efforts, but many are not, and teachers need to experience the value and benefits of cooperative work (NRC, 1996, p.61), and design many activities for group learning, not simply as an exercise but as collaboration essential to inquiry (NRC, 1996, p.50). Working in groups enables students to appreciate the availability of alternative solutions as proposed by their classmates. In IBT students are encouraged to not only learn the details of the knowledge, but also learn to apply them in the solution of relevant problems. Thus, students can be accessed on the basis of their understanding and ability to apply knowledge, rather simply their skill at reciting facts. There is an additional benefit: their transfer into other subjects. For example, this approach of teaching information retrieval was successfully implemented in an undergraduate module where students were assessed in a written examination and a written assignment (Jones, 2009).

Previous researches, which investigated the effectiveness of IBT method on critical thinking of primary school students (Kazempour, 2013), secondary school students (Kitot et al., 2010) or undergraduates (Gao & Quitadamo, 2015; Greenwald & Quitadamo 2014; Magnussen, Ishida, & Itano, 2000; Thaiposri & Wannapiroon, 2015) in different disciplines such as history, biology, science and so on, had showed that IBT was effective in enhancing students' critical thinking, which is an extremely important aspect of creativity (Gao & Quitadamo, 2015; Greenwald & Quitadamo 2014; Kazempour, 2013; Kitot et al., 2010; Magnussen et al., 2000; Thaiposri & Wannapiroon, 2015). IBT has also proven to be more effective in promoting the teaching of information technology than traditional teaching methods (Lu, Liu, & Chen, 2012). A comparative study of problem- and lecture-based learning in junior secondary school science showed that seemingly problem-based learning was favored for knowledge retention, compared to a more conventional teaching method (Wong & Day, 2009). Knowledge is another important component of creativity (David, 1998; Hayes, 1989).

As to the effect of combined of two teaching methods, evidence from some teaching researches showed that combination of LBT and IBT can strengthen the teaching effect—improve the students' academic achievement on Chemistry lessons (Shen, 2009) and Idelogical-Political lessons (Zhou, 2012). According to Babansky's Optimization of the Teaching Process (Babansky, 1973a, 1973b; as cited in Wang, 2012), in the process of teaching teachers should adopt diversified teaching methods: each teaching method has its advantages and disadvantages, teachers should choose appropriate teaching methods according to the concrete situation and pay attention to the integrated use of a variety of methods, in order to achieve the optimization of teaching process.

A current review of literature did not offer much guidance to whether teaching methods have impact on students' creative problem finding (CPF).With this in mind the present investigation compared LBT and IBT in terms of creative problem finding. A combined version, or hybrid, of LBT and IBT was also examined, given that both LBT and IBT may contribute, in different ways, to CPF. The purpose of this study was to explore, over short- and long-term classroom experiences, the impact of LBT, IBT, and mixed teaching on students' CPF performance. The hypotheses were as follows: Different teaching methods differ significantly in terms of the impact on CPF performance. Mixed teaching would be significantly more effective than LBT and IBT, not only in improving the three indices of students' CPF performance, but also in improving students' CPF performance of different instruction type.