

A Four-Component Instructional Model for Teacher Training in Critical-Thinking Instruction: Its Effectiveness and Influential Factors

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Abstract

This study investigated the effectiveness of a training course in critical-thinking instruction with an emphasis on four components that are most likely to bring about teachers' improvement in personal teaching efficacy and teacher behaviors during the training. Eighty-two preservice teachers participated in a 16-week training session in this study. Based on both qualitative and quantitative analyses, the findings suggest that providing guided practice and generating reflective teaching are crucial to the successfulness of a teacher training program and that a training course in critical-thinking instruction does, in fact, produce more lasting effects if it simultaneously imparts professional knowledge, raises personal teaching efficacy as well as heightens reflective teaching. At the same time, it is found that professional knowledge and field practices are indeed decisive in teachers' overall improvement in personal teaching efficacy and teacher behaviors during teacher training.

Keywords: critical thinking, instructional model, personal teaching efficacy, teacher behavior, teacher training, professional knowledge

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It has long been recognized that critical thinking is an effective learning strategy (Halpern, 1998; Jawarneh, Iyadat, Al-Shudaifat, & Khasawneh, 2008; Klein, Olson, & Stanovich, 1997; Lawson, 1999; Roberts-Cady, 2008), the key to emotional intelligence (Elder, 1997) and a prerequisite for leaders in business (Harris & Eleser, 1997; Dilenschneider, 2000). Since students' critical-thinking ability can be significantly improved through effective teaching (e.g. Alshraideh, 2008; Browne & Meuti, 1999; Carmen & Kurubacak, 2002; Ellis, 2001; Hittner, 1999; Jawarneh et al., , 2008; Mackinnon, 2006; McCarthy-Tucker, 2000; Nelson & Oliver, 2004; Semerci, 2006; ; Yanchar, Slife, &Warne, 2009; Yeh, 2008a, 2008b; Yang & Chung, 2009), teacher educators should be held accountable for turning out effective cultivators of critical-thinking skills. Previous studies have suggested that, aside from dispositions, teachers' professional knowledge, personal teaching efficacy, and teacher behaviors are fundamental to the effective instruction of critical thinking (Yeh, 1997, 2007, 2008b). With this in mind, a course which emphasized four components was designed in this study to help teachers to become confident cultivators of critical-thinking skills. Apart from this, this study was conducted to identify the relationships among the fundamental components of effective critical-thinking instruction and to determine the most crucial factors vis-à-vis teachers' professional growth in this area.

Fundamentals of Effective Critical-thinking Instruction

The first of the four fundamental components of effective critical-thinking instruction on the part of a teacher is having a sufficient body of professional knowledge about critical thinking. Shulman (1987) identified three distinct types of professional knowledge: content knowledge, pedagogical knowledge, and pedagogical content knowledge. Content knowledge and pedagogical content knowledge are especially important for teaching such complex-thinking skills as critical thinking, creative thinking and problem-solving. By integrating the concepts of

professional knowledge (Grossman & Richert, 1988) and critical thinking (Alshraideh, 2008; Bailin, Coombs, Browne & Meuti, 1999; Facione, Sanchez, Facione, & Gainen, 1995; Gadzella & Masten, 1998; Giancarlo & Facione, 2001; Halpern, 1998, 2003; Harris & Eleser, 1997; McCarthy-Tucker, 2000; Paul & Elder, 2001; Yeh, 1997, 2008b, 2009), this study redefined content knowledge and pedagogical content knowledge so that “content knowledge” includes a teacher’s understanding of critical thinking and related concepts while “pedagogical content knowledge” takes into account a teacher’s knowledge as to how best to employ appropriate teaching strategies to accommodate students’ needs during the teaching of critical thinking.

As for the second fundamental component of critical-thinking instruction—teacher efficacy, it has been reported that teacher efficacy is closely related to teachers’ adoption of innovation strategies, their commitment to teaching, and their employment of effective classroom strategies (Aguirre & Speer, 2000; Albion, 2001; Guesky & Passaro, 1994; Kulinna & Silverman, 2000). Teacher efficacy is commonly broken down into two factors: teaching efficacy and personal teaching efficacy (Gibson & Dembo, 1984). Since research findings have demonstrated that personal teaching efficacy is a stronger predictor of teacher effectiveness and is more conducive to effective teaching than teaching efficacy (Dembo & Gibson, 1985; Gusky, 1988), this study focuses exclusively on personal teaching efficacy. Accordingly, in teaching critical thinking, a teacher’s personal teaching efficacy refers to his or her confidence with respect to building upon students’ prior knowledge, dispositions and skills related to critical thinking (Yeh, 2006).

Besides professional knowledge and personal teaching efficacy, teacher behaviors, the third fundamental component in effective critical-thinking instruction, play an important role in the teaching of critical thinking. Teacher behaviors that contribute to students’ capacity to learn critical thinking skills can be divided into four categories: behaviors that relate to improving students’ prior knowledge; critical-thinking dispositions; critical-thinking skills; and overall critical-thinking ability. Such teacher behaviors include: increasing students’ prerequisite knowledge; teaching critical-thinking skills, schema-driven strategies, and ways to build a frame of mind which is conducive to thinking; offering a healthy mix of facilitating methodologies by employing an infused-instruction approach as well as anchored instruction; keeping students focused on undertaking tasks; building a constructive learning environment; giving students cues, prompts and positive feedback; supplying examples and practice opportunities; asking higher-

order questions and extended questions; allowing a variety of answers; providing successful learning experiences; rewarding student interactions; encouraging students' engagement in group discussions along with cooperative learning; and monitoring the entire learning process (Alshraideh, 2008; Browne & Meuti, 1999; Chen, 2001; Larson, 2000; Halpern, 1998, 2003; Paul & Elder, 2001; Yeh, 1997; 2007; 2008b).

The fourth and final fundamental component in effective critical-thinking instruction is teachers' own critical-thinking dispositions because they may influence teaching outcomes in a subtle way. In the course of teaching critical thinking, teachers must be self-confident, open-minded, creative in following curricula, sensitive to students' feelings, analytical about students' learning problems and systematic in problem-solving. It need not be explained that such personal teaching traits characterize teachers' critical-thinking dispositions (Giancarlo & Facione, 2001; Halpern, 2003, 2008; Paul & Elder, 2001; Yanchar et al., 2009). As for the relationships among the four fundamental components discussed above, namely a full body of professional knowledge, a high degree of teacher efficacy, positive teacher behaviors and teachers' own wealth of critical-thinking dispositions, Robinson (1995) noted that teachers' existing knowledge and experience had a strong impact on both their development and use of effective teaching strategies. In a computer simulation, Yeh (1997) found that personal teaching efficacy functioned as a mediator between knowledge and teacher behaviors and that, at the same time, the relationship between personal teaching efficacy and teacher behaviors was bi-directional. Hence, in terms of critical thinking, the improvement of teachers' professional knowledge should increase both their personal teaching efficacy and teacher behaviors. Another point is that critical-thinking dispositions are significantly related to individuals' ego-resiliency, which refers to a person's ability to change his or her model of perceptual and behavioral functioning in order to adapt to situational constraints (Facione et al., 1995); such dispositions can be influential on a teacher's learning of professional knowledge and formation of personal teaching efficacy, not to mention his or her adaptation of positive teacher behaviors.

Interventions for Teacher Training in Critical-thinking Instruction

For a training course in critical-thinking instruction to be effective, it must be able to improve

teachers' professional knowledge, personal teaching efficacy, and teacher behaviors. Providing sufficient guided practice and stimulating reflective teaching are two effective interventions to achieve this. Guided practice sessions based on an analytical understanding of teaching events are often more constructive than those in natural settings (Yeh, 2006); furthermore, belief change often comes about as a result of the interaction of practice and reflection in teaching (Tillema, 2000). Guided practice can also lead to mastery with regard to experiences, which has been put forth as a powerful way to enhance teacher efficacy (Bandura, 1995). In support of this, Yeh (2006) concluded that guided practices contribute to preservice teachers' improvements in personal teaching efficacy as it pertains to their teaching of critical thinking. Also relevant in this regard, Tillema (2000) determines that a change in beliefs can be attributed to the interactive effects of practice and reflection in teaching.

The other intervention—reflective teaching—results in instructors' reconstruction of professional knowledge and teacher beliefs as well as improvements in teaching practice (Rodriguez & Sjoström, 1998; Tillema, 2000; Yeh, 2004). Two mechanisms have been found essential for nurturing reflective teaching: self-awareness and mindfulness. Collier (1998) has recently pointed out that building a high level of self-awareness before the student teaching experience is critical to pre-service teachers' learning of reflective teaching and their becoming thoughtful practitioners. Titone, Sherman, and Palmer (1998) also attest to the theory that giving feedback to increase self-awareness and that encouraging "mindfulness" in the teacher-learner setting are effective ways to foster reflective teaching.

Accordingly, while self-awareness and mindful learning contribute to reflective teaching and then encourage the improvements in professional knowledge, personal teaching efficacy, and teacher behaviors, guided practices may carry effects on the employment of reflective teaching as well as the reconstruction of professional knowledge, personal teaching efficacy, and teacher behaviors. It is apparent that four components are crucial to bringing about the improvement of personal teaching efficacy and teacher behaviors in critical-thinking instruction; these components are: (a) increasing self-awareness and mindful learning, (b) reconstructing knowledge and personal teaching efficacy, (c) employing reflective teaching, and (d) conducting guided practices. This study therefore incorporates these four components into the training course in critical-thinking instruction.

Hypotheses

This study examined two hypotheses. The first supposition is that a four-component instructional design which especially emphasizes guided practice and reflective teaching should have a positive impact on a teacher's improvement in the areas of professional knowledge, personal teaching efficacy, and teacher behaviors vis-à-vis critical thinking. The second presupposes that a teacher's critical-thinking dispositions, professional knowledge and field practices correlate with his or her personal teaching efficacy and teacher behaviors during the teaching of critical thinking. The integrated model of the proposed hypotheses in this study is displayed in Figure 1. More details about the four-component instructional design are described in the section of experimental design.

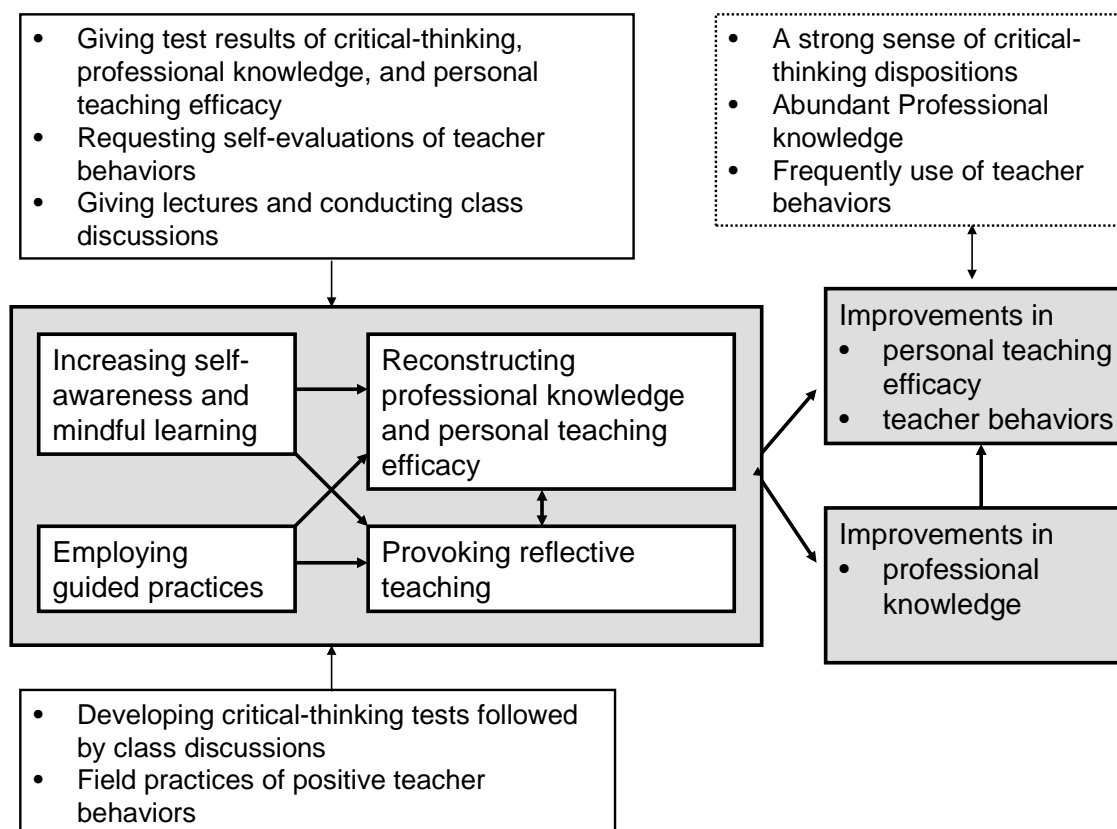


Figure 1. The integrated model of tested hypotheses.

Method

Participants

Eighty-two preservice teachers enrolled in a post-bachelor teacher education program participated in this study. They had an average age of 29.79 years ($SD = 3.41$) and an average teaching experience of 2.81 years ($SD = 1.42$). Among the participants, 38 were males, 44 were females, and of these, 49 were teaching in junior high schools, and 33 in senior high schools.

Instruments

All instruments employed in this study were *The Questionnaire of Dispositions toward Critical Thinking* (QDCT), *The Questionnaire of Professional Knowledge for Critical-thinking Instruction* (QPK-CTI), *The Questionnaire of Personal Teaching Efficacy in Teaching Thinking* (QPTE-TT) and *The Checklist for Teacher Behaviors in Critical-thinking Instruction* (CTB-CTI). The first three of these instruments are 6-point Likert-type questionnaires while the final one is a checklist. QDCT scores indicate the degree of dispositions toward critical thinking. The QDCT, with a Cronbach's α coefficient of .88 (20 items), comprises four factors: systematicity and analyticity, open-mindedness, intellectual curiosity, and reflective thinking. The item response options are "never" to "always," scored from 1 to 6 points (Yeh, 1999). QPK-CTI scores reveal participants' self-evaluation of their own professional knowledge in teaching critical thinking. With a Cronbach's α coefficient of .95 (9 items), the QPK-CTI measures two factors: content knowledge about critical thinking and pedagogical content knowledge about critical thinking. The item response options are "totally disagree" to "totally agree," scored from 1 to 6 points (Yeh, 1999). QPTE-TT scores reflect the trainees' level of confidence in their ability to teach learners to think critically. The QPTE-TT, with a Cronbach's α coefficient of .86 (12 items), assesses three factors: improvement in thinking dispositions, sharpening of overall thinking ability, and broadening of prior knowledge and thinking skills (Chen, 2001). The scoring system of the QPTE-TT is the same as that of the QPK-CTI. Finally, CTB-CTI scores evaluate the frequency of using positive behaviors in teaching critical thinking. The CTB-CTI has a Cronbach's α coefficient of .95 (21 items), and it covers four factors: expanding students' prior

knowledge, upgrading their critical-thinking dispositions, cultivating their critical-thinking skills, and ameliorating their overall critical-thinking ability (Yeh, 1999). Besides these four tests, five reflection items related to instructional design were included to evaluate the participants' attitudes toward the training course. The scoring system for these items is the same as that of the QPK-CTI. The statements which participants evaluated are: (1) The self-evaluation of my personal teacher behaviors enhanced my self-awareness in employing favorable teacher behaviors and, therefore, increased my use of positive teaching behavior for critical thinking; (2) Developing critical-thinking tests contributed to improving my understanding of critical thinking; (3) Developing critical-thinking tests contributed to improving my own critical-thinking ability; (4) Class discussions of critical-thinking test items contributed to improving my critical-thinking ability; and (5) I have often tried to employ positive teacher behaviors for critical thinking this semester.

Experimental design

This study employed a pretest-posttest design. Besides completing the pretests and posttests which were identical, participants attended a weekly two-hour experimental instruction session, the aim of which was to improve the participants' professional knowledge, personal teaching efficacy, and teacher behaviors pertaining to critical-thinking. The instruction lasted for sixteen weeks. The course design emphasized the following four components: (a) increasing self-awareness and mindful learning, (b) reconstructing knowledge and personal teaching efficacy, (c) employing reflective teaching, and (d) conducting guided practices. More specifically, the course design was based on three basic assumptions. First, returning the graded pretest results of all tests to the participants and also telling them the mean averages within the group would increase self-awareness about professional knowledge, personal teaching efficacy and teacher behaviors, which would, in turn, provoke mindful learning during the classes which followed. Secondly, it was assumed that developing critical-thinking tests as out-of-class assignments followed by in-class discussions would improve the participants' understanding of critical-thinking, and this would then further enhance their professional knowledge and personal teaching efficacy. The third assumption was that the employment of guided practice and reflective teaching would result in a more frequent use of positive teacher behaviors; it follows that this would lead to

improvements in professional knowledge, personal teaching efficacy, and teacher behaviors.

Procedures

The step-by-step timing and procedures of the teaching activities are depicted in Figure 2. Two types of test were administered during the semester: Type A tests included three questionnaires for measuring critical-thinking dispositions, professional knowledge, and personal teaching efficacy (QDCT, QPK-CTI, and QPTE-TT). Type B test refers to the checklist for teacher behaviors (CTB-CTI). All participants were administered pretests A in the first class and were subsequently asked to do pretest B based on two periods of classroom teaching (90 minutes in total) which they recorded between the end of the latter part of the first and the early part of the second weeks. The participants were shown their results of Type A pretests in the second week and were given pretest B results in the seventh week. Pretest B results were not immediately returned because, as a self-evaluation checklist, it was believed that a full understanding of each checking item was required to enable participants to analyze the self-evaluation items. A thorough lecture and a discussion of the self-evaluation checking items had been held in the sixth week. Toward the end of the semester, the participants were required to do posttest B (again by recording their teaching and doing follow-up self-evaluations). The posttest B results were given in the sixteenth week before posttests A were administered. The five reflection items were added to posttests A.

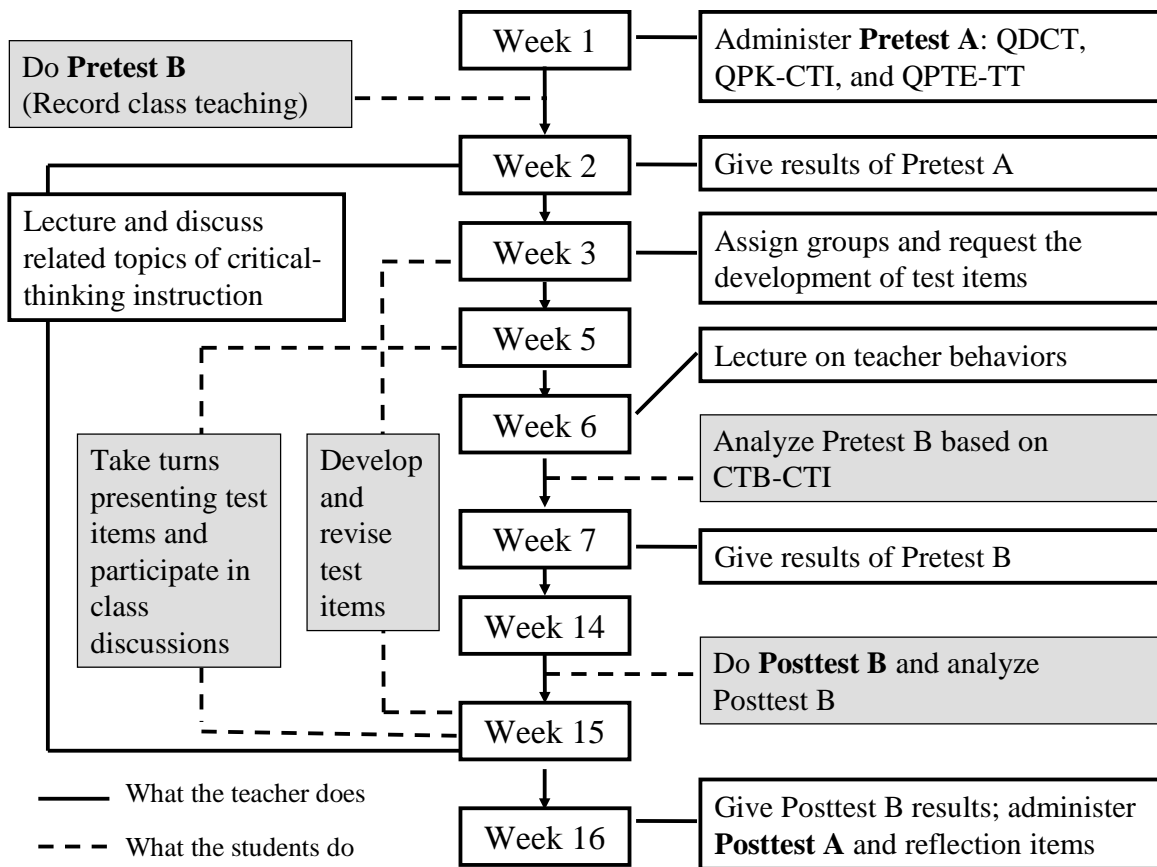


Figure 2. Flowchart of instructional procedures.

As for teaching activities, all participants were randomly assigned to groups of four or five people during the third week. Each participant was asked to develop one multiple-choice test item geared toward other teachers for each of the following critical-thinking skills: assumption identification, induction, deduction, explanation, and the evaluation of arguments. These concepts had been explained in the preceding week. From the fifth week on, the groups took turns presenting their test items to the class; 40- to 50- minute discussions on the test items followed each week. Meanwhile, lectures and discussions on topics related to critical-thinking instruction continued from the second week to the fifteenth week. The main topics for the lectures included: (a) definitions and components of critical thinking, (b) factors that influence the learning of critical thinking; (c) teaching approaches; (d) instructional models; (e) curriculum design; (f) effective teacher behaviors, (g) effective student behaviors, and (h) teaching strategies.

Results

Effectiveness of the training course

Three repeated measures analyses of variance were employed to examine the changes among the participants in terms of the three indices for effective critical-thinking instruction: professional knowledge, personal teaching efficacy, and teacher behaviors. It should be noted that the employed data of teacher behaviors in this study, as determined by Test B, were analyzed by the researcher. The correlation coefficient of the CTB-CTI scores between the researcher and the participants was .93. The means and standard deviations of the QPK-CTI, QPTE-TT and the CTB-CTI are displayed in Table 1. The first and the third analyses yielded significant effects (Wilks' Λ = .18 and .70, respectively, $ps < .001$), whereas the second analysis did not (Wilks' Λ = .99), thus demonstrating that the training course significantly improved the teachers' perceived professional knowledge and their use of positive teacher behaviors but not their personal teaching efficacy. Subsequent paired t-tests and comparisons of the means revealed that the teachers' perceived knowledge in both content knowledge and pedagogical content knowledge pertaining to teaching critical thinking had significantly increased in the posttest than in the pretest, $ts(62) = 14.88$ and 19.53 , $ps < .001$. Moreover, the teachers reported that they were employing more favorable teacher behaviors to improve students' prior knowledge, critical-thinking dispositions, critical-thinking skills, and overall critical-thinking ability at the time of the posttest than they were at the time of the pretest, $ts(71) = 4.45, 4.34, 5.01, \text{ and } 5.78$, $ps < .01$, respectively.

Table 1

Means and Standard Deviations of the QPK-CTI, QPTE-TT, and CTB-CTI

Inventory	Pretest		Posttest	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
QPK-CTI (<i>n</i> = 65)				
Content knowledge	2.30	.93	4.26	.72
Pedagogical content knowledge	1.99	.84	4.20	.82
QPTE-TT (<i>n</i> = 71)				
Enhancing thinking dispositions	4.12	.62	4.23	.68
Improving overall thinking ability	4.31	.58	4.39	.68
Increasing prior knowledge and thinking skills	4.43	.54	4.42	.56
CTB-CTI (<i>n</i> = 74)				
Increasing prior knowledge	2.38	1.37	3.42	1.84
Enhancing critical-thinking dispositions	14.95	9.25	24.05	16.67
Improving critical-thinking skills	8.69	8.76	16.95	14.02
Improving critical-thinking ability	3.07	3.08	6.69	5.69

To further confirm the effectiveness of the employed interventions, the relationships between the three indices for effective critical-thinking instruction and the five reflection items related to the interventions were analyzed. On a six-point scale, the mean scores for the five items were 5.08 (*SD* = .89), 5.03 (*SD* = .90), 4.95 (*SD* = .92), 5.15 (*SD* = .90), and 4.69 (*SD* = .93), respectively. The results of Pearson correlation analyses clearly showed that each of the five items and the three indices of effective critical-thinking instruction had a positive correlation (see Table 2). Of particular interest is that all five items had the highest degree of correlation with professional knowledge, $r_s(76) = .58$ to $.78$, $p_s < .001$. Noteworthy too is that the second highest correlation was with personal teaching efficacy, $r_s(76) = .51$ to $.61$, $p_s < .001$. Comparatively, each of the five items had a significantly lower degree of correlation with teacher behaviors, $r_s(76) = .21$ to $.35$, $p_s < .05$. As a result of the findings, it can reasonably be stated that the teachers had a positive attitude toward the training course. Furthermore, the correlation coefficients suggest that there was a certain degree of training effect as shown in the teachers'

improvement in terms of personal teaching efficacy though the effect was not significant in the repeated measures analyses of variance.

Table 2

Correlations among the Scores of Professional Knowledge, Personal Teaching Efficacy, and Teacher Behaviors in the Posttest and Five Reflection Questions

	Q1	Q2	Q3	Q4	Q5
Posttest professional knowledge	.58***	.78***	.70***	.75***	.67***
Posttest personal teaching efficacy	.54***	.57***	.51***	.56***	.61***
Posttest teacher behaviors	.21*	.32**	.35***	.22*	.32**

* $p < .05$. ** $p < .01$. *** $p < .001$.

The relationships among the four fundamentals of effective critical-thinking instruction

Two canonical correlation analyses were used to investigate the relationships among the four fundamental components of effective critical-thinking instruction. Both analyses involved two independent variables (IV, critical-thinking dispositions and professional knowledge for teaching critical thinking) and two dependent variables (DV, personal teaching efficacy for critical thinking and teacher behaviors for critical thinking). However, the first analysis employed the pretest scores, whereas the second one used the posttest scores. The first analysis yielded a significant canonical correlation (Wilks' $\Lambda = .73$, $p < .001$). The canonical correlation was .51, representing 26% overlapping variance for the pair of canonical variates. The pair of canonical variates had a high factor loading on critical-thinking dispositions (.85) on the IV side and a high factor loading on personal teaching efficacy (.94) on the DV side, which indicates that critical-thinking dispositions and personal teaching efficacy seem to have had a strong positive correlation in the pretest (see Table 3).

Table 3

Canonical Correlation Analysis of Pretest IVs and Pretest DVs

	Canonical variate		
	Correlation	Coefficient	
Pretest IV set			
Critical-thinking dispositions	.85	.92	
Professional knowledge	.42	.54	
Percent of variance			Total = .45
Redundancy			Total = .11
Pretest DV set			
Personal teaching efficacy	.94	.83	
Teacher behaviors	.61	.36	
Percent of variance			Total = .63
Redundancy			Total = .16
Canonical correlation (ρ)	.51		
Squared canonical correlation (ρ^2)	.26		
Wilks' Λ	.73 ***		

*** $p < .001$.

The second analysis also yielded a significant canonical correlation (Wilks' $\Lambda = .46$, $p < .001$). The canonical correlation was .73, representing 54% overlapping variance for the pair of canonical variates. The pair of canonical variates had a high factor loading on professional knowledge (.99) on the IV side and a high factor loading on personal teaching efficacy (.99) on the DV side. Therefore, as shown in the posttests, abundant professional knowledge is most assuredly related to a strong sense of personal teaching efficacy (see Table 4).

Table 4

Canonical Correlation Analysis of Posttest IVs and Posttest DVs

	Canonical variate		
	Correlation	Coefficient	
Posttest IV set			
Critical-thinking dispositions	.30	.12	
Professional knowledge	.99	.97	
Percent of variance			Total = .54
Redundancy			Total = .29
Posttest DV set			
Personal teaching efficacy	.99	.96	
Teacher behaviors	.40	.12	
Percent of variance			Total = .57
Redundancy			Total = .31
Canonical correlation (ρ)	.73		
Squared canonical correlation (ρ^2)	.54		
Wilks' Λ	.46 ***		

*** $p < .001$.

The most crucial factors for improving personal teaching efficacy and teacher behaviors

To further understand the most crucial factors related to teachers' improvements in personal teaching efficacy and teacher behaviors, a third independent variable, "frequency of practicing teacher behaviors," was added to the foundation of the second canonical correlation and then reanalyzed. The analysis yielded a significant canonical correlation (Wilks' $\Lambda = .42, p < .001$) of .76, representing 58% overlapping variance for the pair of canonical variates. The pair of canonical variates had a factor loading on professional knowledge (.96) and frequency of practicing teacher behaviors (.86) on the IV side and a high factor loading on personal teaching efficacy (.99) on the DV side. Thus, on the basis of the results of the posttests, there is strong evidence to support the theory that abundant professional knowledge and frequent practice of teacher behaviors are related to having a strong sense of personal teaching efficacy (see Table 5).

Table 5

Canonical Correlation Analysis between CT-Dispositions, Professional Knowledge, Practicing Frequencies and Posttest DVs

	Canonical variate		
	Correlation	Coefficient	
Posttest IV set			
Critical-thinking dispositions	.28	.14	
Professional knowledge	.96	.68	
Frequency of practicing teaching behavior	.84	.37	
Percent of variance			Total = .56
Redundancy			Total = .33
Posttest DV set			
Personal teaching efficacy	.99	.96	
Teacher behaviors	.39	.11	
Percent of variance			Total = .57
Redundancy			Total = .33
Canonical correlation (ρ)	.76		
Squared canonical correlation (ρ^2)	.58		
Wilks' Λ	.42 ***		

*** $p < .001$.

Discussion and Conclusions

Effectiveness of the training course

This study employed a four-component design to improve teacher effectiveness in teaching critical-thinking by: (a) increasing self-awareness in terms of professional knowledge, personal teaching efficacy and teacher behaviors when participants were given their test results; (b) helping to reconstruct professional knowledge and personal teaching efficacy by means of lectures and class discussions; (c) encouraging reflective teaching by increasing self-awareness

and mindful learning, and (d) improving professional knowledge, personal teaching efficacy and teacher behaviors through guided practices. By and large, the participants' positive attitudes towards the instructional design and the significant results from the related analyses suggest that the instructional design that was developed here was effective in achieving the presumed instructional goals although its effects on personal teaching efficacy were not as strong as the impacts on professional knowledge and teacher behaviors. Nevertheless, the findings in this study not only support the notion that teacher effectiveness in teaching critical thinking can be significantly improved by means of a well-designed course (Yeh, 1997, 2008a, 2009) but also demonstrate that guided practice and reflective teaching are powerful tools for teachers' professional growth (Carter, 1990; Collier, 1998; Tillema, 2000, Yeh, 2004). Evidence that led to these conclusions is observed, first, in the teachers' significant improvements in professional knowledge and teacher behaviors and, secondly, in the strong correlations between the first and the fifth reflection items and the posttest scores of professional knowledge, personal teaching efficacy, and teacher behaviors. Moreover, this study confirms that those with a greater wealth of professional knowledge at the completion of the training tended to highly value and benefit from opportunities to evaluate their own teacher behaviors, which agrees with the claim by Rodriguez and Sjoström (1998) that reflective teaching is related to professional knowledge. As a result, it can be said with confidence that guided practice and self reflection in teaching are crucial to teachers' acquisition of professional knowledge, development of personal teaching efficacy, and employment of effective teacher behaviors during the teaching of critical thinking.

Another important intervention found in this study is the inclusion of class discussions. It had been earlier hypothesized that devising critical-thinking tests followed by class discussions would contribute to teachers' improvements in both professional knowledge and personal teaching efficacy. The following findings support this: (a) there was a significant change in knowledge at the completion of the training course; and (b) there was a high correlation between the second, third, and fourth reflection items and the posttest scores of professional knowledge along with personal teaching efficacy. These findings help validate the idea that discussions generally contribute to learners' understanding of a topic and the development of critical thinking (Yeh, 2008b, 2009). In brief, class discussions are most probably one of the most effective ways to increase professional knowledge and personal teaching efficacy in a specific domain.

Crucial factors for improving personal teaching efficacy and teacher behaviors

This study investigated the predictive powers of professional knowledge and critical-thinking dispositions on teachers' personal teaching efficacy and teacher behaviors in both the pretests and the posttests. Though there were significant canonical correlations for both analyses, the correlation patterns were different. In the pretests, critical-thinking dispositions were a better predictor of personal teaching efficacy and teacher behaviors than was professional knowledge. By contrast, in the posttests, professional knowledge became a better predictor than critical-thinking dispositions. The low predictive power of professional knowledge in the pretests may have been due to the low variance—almost all of the teachers had very limited professional knowledge about teaching critical thinking (The mean for content knowledge was 2.30 and for pedagogical content knowledge 1.99). However, upon completion of the training course, the teachers' professional knowledge had significantly improved (The mean for content knowledge was 4.26 and for pedagogical content knowledge 4.20). These results strongly imply that professional knowledge is a more influential factor in teachers' enhancement of personal teaching efficacy and their use of teacher behaviors than critical-thinking dispositions. It is therefore important to help teachers-in-training build up professional knowledge, especially that of pedagogical content knowledge. On the basis of the results of this study, it appears that in addition to professional knowledge, a large number of practice sessions is a crucial factor in teachers' improvement in personal teaching efficacy and teacher behaviors vis-à-vis critical thinking. According to Tillema (2000), reflection after practice is a more fruitful way of affecting student teachers' belief change than preparing them to be reflective before they enter their practice teaching. This study, however, encouraged reflection both before and after practice by means of giving test results and requesting self-evaluations of teacher behaviors twice during the training. The results here suggest that such a reflection approach may be a more effective way than a pure reflection-after-practice approach in terms of raising the motivational force of teaching practice sessions in improving teacher effectiveness.

Conclusions

Preparing confident cultivators of critical thinking and nurturing reflective teachers can not

be over emphasized in teacher education. To achieve this educational ideal, as a teacher educator, I designed a training course which featured a four-component process with a special focus on guided practice and reflective teaching. The findings in this study indicate that the instructional design and interventions incorporated in the training course were effective. In essence, the study findings show that teacher effectiveness in teaching critical thinking can be improved as long as the training course is meticulously designed. Worthy of special note, however, is that a training course in critical-thinking instruction can indeed produce more lasting effects if it imparts professional knowledge, raises personal teaching efficacy as well as enhances reflective teaching all at the same time. This study has also developed instruments in the form of questionnaires for measuring four fundamental components of a successful critical-thinking instruction; these tools will be valuable in further research. Finally, the teacher training in this study was focused more on the use of the “direct approach” for teaching critical thinking, in which critical-thinking skills are regarded as general skills. Further studies may apply this instructional design with the “infusion approach”, thus focusing more on how to teach critical-thinking skills in a specific domain.

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