行政院國家科學委員會專題研究計畫成果報告

我國國民中學教師專業知能的成長階段（II）：專家教師、一般教師與新任教師的區別與觀察研究

Teaching efficacy along the development of teaching expertise among math and science teachers in Taiwan

計畫編號：NSC 87-2413-H-009-001
執行期限：86 年 8 月 1 日至 87 年 7 月 31 日

主持人：林珊如　　國立交通大學教育學程中心

一、中文摘要

本研究延伸 86 年同一名稱之研究案，目的在探索職前、新任、專家數學與物理教師之專業知識結構與教學效能信念間的關連度。學生學習數學或理化時往往易生畏懼之心，因此教師發展專業知能、成為優良教師的歷程中，教學動機或專業堅持感是成就專業地位不可少的因素，教學效能即屬於教學動機的變項。

本研究兼採質與量的研究方法，31 位研究對象含 12 位職前訓練的教育學程學生，8 位第一年教學的新手教師，7 位專家教師。專業知識結構的測量是要求受試者發聲思考，發表對教學錄影的評論，登錄系統及內容分析方式詳見 Lin（1999）。另採用王（民 84）國民中小學教師教學效能量表，分為一般效能及個人效能兩向度。

由於受試人群數不大，因此建議不應過度推論，量化研究結果發現新任與專家教師都比職前教師的教學效能總分高。其中個人效能隨教學專業知能的成熟而遞增，專家教師對自己的教學效能最有信心。但是新任教師的一般效能最高，專家教師較低，而以職前教師為最低，顯示新任教師對一般教育系統最具信心。其結果隱含著：個人效能感可能是追求專業知能成長的重要因素，或著成熟的教師專業知識結構內應包含教學效能感在內。

分析三類群教師專業知識結構中有關教學效能的典型語句，顯示我國職前教師並不像 Weinstein (1988)的研究發現美國職前教師對自己的教學能力有不可救藥的樂觀看法。我國職前教師在施展教學或管理策略時較為舉棋不定，雖能建議策略，卻沒有信心，對自己的努力不知能否得到成果，對教學錄影帶中的教師表現有較負面的評語。

專家教師的專業知識不但內容豐富、種類繁多、關連綿密。他們認為對學生的影響而言，外在環境與老師是同等重要的因素，他們認為自己具備的教學、管理知能能把學生教得不錯，雖然其中有些比較偏重班級管理，有些則著重於教材、學生、教法、與教師特性的動態關係，對教學錄影帶中的教師表現多為鼓勵支持，也能理解老師在面對難以帶動的學生時之奮鬥掙扎。

關鍵詞：教師認知、教師效能、教師專業知能

Keywords: Teacher Cognition, Teaching Efficacy, Teaching Expertise

Introduction

For many teacher education programs the development of effective teacher may become one of their primary goals. In achieving it, cognitive as well as affective development should be emphasized adequately. Though research has shown

teachers' sense of efficacy, an affective variable, as a significant indicator of effective teachers (Brandt, 1986), we know little about relationship of teaching expertise and teaching efficacy. During career development, teacher's theoretical knowledge elaborates and translates into practice. However, knowledge alone cannot make a distinguished teacher. An effective teacher must motivate himself/herself internally or externally to achieve excellence.

Different studies have revealed teachers' senses of teaching efficacy in the groups of teachers in general, student teachers, and pre-service teachers (Ashton & Webb, 1986; Gibson & Dembo, 1984; Hoy & Woolfolk, 1990; Woolfolk & Hoy, 1990). However, previous study never adopts novice-expert difference approach in the investigation. Therefore, research question in this study was to examine the relationship between knowledge structure and teaching efficacy for teachers with differential expertise. A qualitative research method was adopted in order to gain a closer look about the role of teaching efficacy in their pedagogical knowledge and visual information processing.

We are particular interested in science and math teachers' sense of teaching efficacy because regardless students' achievement, many students in Taiwan feel frustrated or indifference about science or math. They may avoid science and math learning if possible. In such circumstance, teacher's sense of teaching efficacy becomes even more important to his/her task persistence. The participants were a small amount of secondary in-service and pre-service teachers who were categorized as novices, beginners, and experts. The invitation of participants across two subject matter areas may increase the external validity of the research, but there is a trade-off. Two sets of slides taken from either science or math classes were used as interview stimuli to match teachers' majors, because it is not reasonable for math teachers to comment on science class events and vice versa.

Sense of teaching efficacy

Teacher's sense of efficacy has defined by Ashton (Ashton, 1985; Ashton & Webb, 1986) as teacher's belief in their ability to produce effective student learning. Teacher's sense of teaching efficacy is a moderator toward several significant educational variables, such as student achievement (Gibson & Dembo, 1984), student motivation (Midgley, Feldlaufer, & Eccles, 1990), teachers' attitude toward innovation (Guskey, 1988, superintendents' evaluation of teacher performance (Trentham, Silvern, & Brogdon, 1985), and teachers' classroom management strategies (Ashton & Webb, 1986).

Some factors assumed to be predictors of teaching efficacy were indicated by research.. Ashton & Webb (1986) found that in-service teachers had a relative low sense both in personal efficacy and general sense of teaching efficacy. Hoy & Woolfolk (1990) reported that experience of student teaching brought down student teachers' general sense of teaching efficacy. After one year of student teaching, student teachers were less sure that education could overcome the limitations of home environment and family background. Whereas, student teachers' personal teaching efficacy were higher after student teaching. They became more confident about their own abilities to enhance students' learning. In the same study, prospective teachers in teacher education programs reported high

scores in personal efficacy as well as general sense of teaching efficacy. This result was in accord with Weinstein's (1988) finding about prospective teachers' strong tendency of "unrealistic optimism".

Based on the scales of Change Agent Study by Rand Corporation (Berman & McLaughlin, 1977) and Gibson & Dembo (1984), a revised Chinese version, Taiwan Teaching Efficacy Scale (TTES), were developed in Taiwan (Wang, 1991). In this study TTES was adopted as to measure the sense of teaching efficacy. Two factors were found, namely, personal efficacy and general sense of teaching efficacy in TTES. Though they were named after factors of previous studies, some differences deserved our attention. In TTES, all items loaded in personal efficacy factor represent the teacher's sense of personal contribution in student learning and personal power in minimizing inadequate influences of external factors. General teaching efficacy factor reflects a teacher's belief that all other teachers' abilities to bring about change and their possibilities to diminish confrontation of external factors. Two sub-dimensions were drawn in both efficacy factors (see table 1), one concerning teachers' skills of planning lessons, selecting materials, and adopting teaching and management strategies to accommodate students' individual differences. The second sub-dimension draws teachers' opinion toward external factors, such as family background, parental influences, mass media, and peers.

Factors extracted from Gibson & Dembo and previous research were not further split into sub-dimensions. The factor of personal teaching efficacy contains only the teaching skill sub-dimension of personal teaching efficacy in TTES. And factor of general teaching efficacy represents only the external factor sub-dimension in TTES. Table 1 visually displayed the differences of factor contents between TTES and previous research.

Wang's study included 1679 elementary and secondary school teachers in Taiwan and claimed TTES to be a reliable and validate scale. In short, teachers who were rated higher by peers and school administrators gained higher scores in TTES. Higher efficacy teachers can be described as: male, serving in a secondary and a smaller school, with master degree, achieving positive interpersonal relationship with students, parents, peers, administrators, and principals, perceiving positive community influence toward education society, and satisfied with teachers' vocational status. Secondary in-service teachers had relative moderate general sense of teaching efficacy and personal efficacy, about 3 in a 5-point scale. Regardless length of teaching experience (grouped as 5 years and less, 6-15 years, 16-25 years, and 26 years and more), all teachers had similar sense of teaching efficacy.

Expert-novice Research

Results of the research on expert novice difference showed that expert and novice teachers see classroom events differently because they know differently (Berliner, 1986; Borko & Livingston, 1989; Leinhardt, 1989; Leinhardt & Greeno, 1986; Livingston & Borko, 1989; Saber, Cushing, & Berliner, 1991; Perterson, 1988; Peterson & Comeaux, 1987; Shulman, 1986; Strahan, 1989; Westerman, 1991; Wintzky, Kauchak, & Kelly, 1994). The knowledge that expert teachers bring into classrooms allows them to infer accurately and efficiently, to screen irrelevant information, to comprehend the meaning behind classroom activities

(Swanson, O'Connor, & Cooney, 1990). In a serial studies, Berliner and his colleagues found that expert teachers performed better to: 1) monitor and comprehend classroom events, 2) interpret the instructional strategies used, 3) hypothesize reasons for behavior seen, and 4) offer solution for classroom problems occurred. Berliner implied that these differences could be accounted for by expert and novice's knowledge structure and reasoning skills.

In general, previous novice-expert teacher studies focus on teachers' knowledge and information processing and lack of description about teaching motivation of experts or novices.

Methods

Participants

All participants were in-service or pre-service teachers of science or math. Novices in this study were 12 pre-service teachers; currently taking teacher education programs at two Research Universities in Taiwan. They all maintained outstanding achievement both at their major departments and teacher education programs. The beginners were 8 outstanding student teachers in the first year of teaching, graduated from the same universities. Six expert teachers with average 11 years of teaching were recommended by professors of teacher education programs through observations of their instruction. In addition, they either have served as senior teaching consultants in school district or chairs of science/math teacher committees in local schools.

Procedures

One set of slides represented consecutive events of a typical science class, the other math class. One class period of junior high science classroom and one of math were videotaped from two camcorders for a whole week. For both classes, six tapes were selected and edited into two sets of 118 digital slides, later were displayed by Microsoft Power Point to the participants. The events were selected to show teachers' presentation of content, interaction among the teacher/students and students groups, and involvement of students.

In the first experiment phase, a participant from the expert, beginner, or novice groups was shown slides and asked to freely express their comments. They could stop the slides whenever they wished to make comments and their questions about classroom events were answered by the interviewers. Average length for the think-out-loud procedures for 27 participants was 78 minutes. At the second phase, they were asked to answer TTES.

Data Analysis

Participants' comments were recorded and transcribed for analysis. Protocols were coded by two researchers through several refine cycles in which categories were split or combined to accurately represent the data. The two coding systems were modified from Carter, Cushing, Sabers, Stein, and Berliner (1988). The first system, content of comments contained 10 domains: math content/structure, instructional strategies, classroom management, classroom climate, student behavior/attitudes, teacher roles, classroom context, educational system, community and school, educational theories. Furthermore, 50 sub-domains were identified under original 10 domains. Second, nature of comments included 6 levels: question, description, interpretation, evaluation, conclusion, and suggestion. Descriptive statistics were adopted to analyze domain

and breadth of instructional knowledge, levels of comment nature and teaching efficacy. After the initial coding, researchers selected statements from 10 domains of pedagogical knowledge to represent exemplars of teaching efficacy for experts and novices.

Conclusions

In the analysis of quantitative data, both experts and beginners reported higher teaching efficacy than novices did. However in a closer look, personal teaching efficacy displayed an increasing tendency along the development of expertise. The limited sample size and pilot nature of this study was recognized and therefore raw data were reported and interpreted descriptively. Experts had the greatest confidence that their abilities cast positive influence on student learning, while novices the least. For general teaching efficacy, beginners gained higher than novices did, whereas experts dropped a little which still was higher than novice group though.

This finding adds complimentary sketch to previous study about Taiwan secondary teachers' sense of teaching efficacy (Wang, 1991). Wang found that teachers, no matter how long they teach, had moderate sense of teaching efficacy. The quantitative data (in table 2) suggested that sense of teaching efficacy may play an important role in the persistence of professional growth among our participants. Our participants' construction of teaching expertise may require strong sense of teaching efficacy, especially personal efficacy. Or metaknowledge about teaching efficacy is an important component of pedagogical knowledge.

Novices' exemplars of general sense of teaching efficacy revealed that they were not unrealistic optimists about what general education system can do as what Weinstein and Hoy & Woolfolk observed in American teachers. Their exemplars of sense of personal efficacy reflected the uncertainty in coming up with a strategy, less confident about their suggestion of teaching practice, passive opinion about effects of teacher's efforts, and also more negative evaluation on what the teacher actors did in the slides.

Expert teachers commented on more domains of pedagogical knowledge as well as more details in each domain. Exemplars of the general sense of teaching efficacy represented that experts put equal weights on teacher's own influence and external factors in bring about change. Their exemplars about sense of personal efficacy showed their confidence on every aspect of teaching practice, though some experts expressed more on classroom management and others more on dynamic relationship among content, student, instruction, and teacher per se. Their comments about the teacher actors were predominately encouraging and understanding the struggle to get through to most difficult students.

Table 1: Factors and subdimensions of TTES and the two shadowed cells representing contents of factors extracted from previous research

	General sense of teaching efficacy	Personal Teaching efficacy
Subdimensions of TTES	External factor	External factor
	Teaching skill	Teaching skill

Table 2: Means of general sense of teaching efficacy, personal efficacy, and sum in three groups (numbers in parentheses indicating means in a 5-point scale).

		General Sense of Teaching Efficacy		Personal Efficacy		Sum
Novice	External	34	67 (3.35)	33	61 (3.05)	128 (3.20)
N=12	Skills	33		28		
Beginner	External	37	72 (3.60)	34	66 (3.30)	138 (3.45)
N=8	Skills	35		32		
Expert	External	34	69 (3.45)	35	74 (3.70)	143 (3.58)
N=6	Skills	35		39		