

# DEVELOPMENTAL VERSUS DIFFERENCE APPROACHES TO SELF-EFFICACY BELIEFS OF MATHEMATICS TEACHERS

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**Abstract:** The developmental approach to efficacy beliefs of mathematics teachers is based on the view that comparisons between experienced and beginner teachers at the beginning of their career should indicate no substantive differences in the structure of their efficacy beliefs towards mathematics teaching. In contrast, the difference approach states that such comparisons will often reveal major deficits in efficacy beliefs. As far as we know there are no research studies discussing the developmental and difference approaches to self-efficacy. We argue that aspects of the conceptual and methodological foundations on the theory of developmental and difference approach are important for any effort to change efficacy beliefs. A paradigm based on regression analysis is recommended as the starting point for further theoretical and methodological work in the area.

Self-efficacy influences several aspects of behavior that are important to teaching and learning. Teachers' efficacy beliefs have been related to student achievement, student motivation, teachers' adoption of innovations, teachers' management strategies, and teachers' strategies in instruction (Christou & Philippou, 1998; Cooney, Shealy, & Arvold; Kyriakides, 1998; Pajares, & Miller, 1995; Woolfolk, Rossoff, & Hoy, 1990). In these studies, with a few exceptions (Pajares, & Miller, 1995), efficacy was generally assumed to be the independent variable. In this paper, we consider teachers' efficacy beliefs as the dependent variable and we propose both a theoretical and a methodological model linking teachers' efficacy beliefs with teaching experience. The proposed theoretical model reconciles two competing conceptual strands found in the literature: The first strand assumes a developmental approach to teaching efficacy, while the second one emphasizes the differences found among teachers. The methodological model refers to a new design based on the regression analysis through which both the developmental and the difference approaches can be discussed.

## THEORETICAL BACKGROUND

**The Concept of Teaching Efficacy:** The conceptualization of teacher efficacy is based on the theoretical framework of self-efficacy developed by Bandura (1997). Bandura (1997) defined perceived self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). In the same sense, teaching efficacy, which is a form of self-efficacy beliefs, can be defined as teachers' beliefs in their abilities to organize effective teaching-learning environments and have positive effects on student learning.

Recently, Soodak and Podell (1996) found that teacher efficacy is comprised of three factors labeled as Personal Efficacy (PE), Outcome Efficacy (OE), and Teaching Efficacy (TE). PE refers to teachers' beliefs that they have the skills to bring changes in students' behavior and performance, while OE refers to the belief that, when teachers implement those skills, they can achieve desirable outcomes. The TE factor refers to teachers' beliefs that teaching in general can lead to students' successful performance overcoming influences outside the classroom which affect learning, including children's home environment.

**The Developmental - Difference Theory in Teaching Efficacy:** The developmental and difference theory, as proposed in the present study, has its roots in the psychology literature (Cole, 1998). One of the purposes of the present study is to apply the developmental and difference theory in the field of teaching efficacy. In the following paragraph, we first explain the terms of internal and external factors, which are used throughout the study, and then we briefly discuss the developmental and difference theory as it may apply to teaching efficacy.

The internal variables refer to the extent to which teachers feel equipped with the tools needed to teach the classroom mathematics (Ross, Cousins, & Gadalla, 1996). By internal variables we mean all those variables that are closely related to teachers' attitudes and most importantly to teachers' feelings of being well prepared. By external variables, we mean all those variables called by Ross et al. (1996) as between variables such as the teaching experience, the age, and the gender of teachers or other environmental factors as described by Bandura (1997). In this study, we examine the developmental-difference theory with respect to only one external factor, the teaching experience of teachers. However, the results and conclusions of the present study can be replicated in such a way as to include a number of other external factors.

**The developmental Theory:** According to Bandura (1997) efficacy beliefs among teachers may be best conceptualized as following a developmental sequence. The concept of developmental sequence, in the context of the present study, assumes that teachers in their early years of experience have the opportunity to develop a sense of efficacy as professionals in the field. It is also assumed that teachers during their career constantly develop teaching efficacy beliefs, but the basic structure of their beliefs does not substantially differ from the beliefs they demonstrate throughout the years in the profession. We advocate that the continuity in the efficacy beliefs of teachers of mathematics holds true provided that teachers are equated on internal factors. The matching of teachers on internal factors provides a more complete picture of teachers' development of self-efficacy, because the internal factors are more salient in shaping efficacy beliefs especially when teachers lack experience (Tschannen-Moran, Hoy, and Hoy, 1998). Thus, the first proposition of the developmental approach to efficacy beliefs states that if teachers of mathematics equated on internal factors have a similar pattern of teaching efficacy irrespective of external variables. This is the

notion of the similar-structure hypothesis put forward in the framework of the developmental models in conjunction with the similar sequence hypothesis. The similar sequence hypothesis predicts that experienced and inexperienced teachers pass through the same phases of teaching efficacy development, differing only in the rate at which they progress and the ultimate ceiling they attain. The similar structure hypothesis involves the view that experienced and inexperienced teachers have similar processes underlying their teaching. There is also a second proposition contained in the developmental theory and it is subsidiary to the first. This second proposition states that if there are differences between internal-matched groups of teachers with regard to teaching efficacy, then these differences are likely to relate to exogenous factors such as motivation, adjustment, personality, and other background factors associated with environmental variables.

**The difference theory.** In contrast to the developmental theory, the difference theory states that comparisons between teachers with different external factors, often reveal major differences in teaching efficacy, irrespective of the internal variables. The difference position, in other words, states that even when teachers of mathematics are equated on internal factors, there would be differences in their teaching efficacy. The difference approach supports the view that any pattern of deficits in teaching efficacy is related to external factors such as experience, cultural factors and gender. Much of the research provides evidence that teaching efficacy is at an inferior level in inexperienced teachers compared with experienced teachers (Sanders, Borko, & Lockar, 1993). In addition, the aim of those who support the difference model is to show that the relationships between external factors and teaching efficacy are essentially different in teachers with or without long experience.

Difference theorists may reject the assumptions of the developmental theory. They may point out that teachers with different external factors demonstrate quite different feelings of teaching efficacy. Sanders, et al. (1993), for example, claimed that inexperienced teachers perform at substantially lower levels on key measures of teaching efficacy than experienced teachers, because they have difficulties in selecting appropriate examples and activities for their students. In the same way, Saber, Cushing, and Berliner (1991) found that experience levels are crucial for explaining teachers' differences in teaching efficacy, because beginning or inexperienced teachers were not able to interpret adequately instructional strategies and hypothesize reasons for different student behaviors.

Much of the research revealed contradictory findings about experienced and inexperienced teachers' efficacy. Two patterns of results emerged: First, a number of studies indicated that teaching efficacy increases with experience (Dempo & Gibson, 1985), and thus teaching efficacy in experienced teachers is higher than in inexperienced teachers (Lin & Tsai, 2000). On the other hand, Ross

et al. (1996) reported that novice teachers had strong sense of teaching efficacy. There are several reasons of this conflict. Lin and Tsai (2000) referred to different measurement tools, to cultural differences and variation in the sample groupings. Besides those justifications, there are also some important theoretical and methodological issues.

### THE AIMS AND HYPOTHESES OF THE PRESENT STUDY

Comparing the means of experienced and inexperienced teachers in teaching efficacy scales is the prevalent research paradigm adopted by almost all studies purporting to make comparisons between the groups of individuals with and without long experience in teaching. In the present study a different approach was applied in discussing the developmental and difference debate in experienced and inexperienced teachers. Specifically, according to developmental theory, the relationship between teaching efficacy, and attitudes and preparatory programs is the same in both the experienced and inexperienced teachers, despite the fact that, in some cases, the inexperienced group may demonstrate a lower level on measures of teaching efficacy. On the other hand, the difference theorists may state that the relationship of teaching efficacy and internal factors of experienced teachers is substantially different from that of the inexperienced. In this respect, the following two related hypotheses were stated:

- (a) The teaching efficacy of inexperienced teachers is comparable to that of experienced teachers matched on internal factors, and
- (b) The relationship between teaching efficacy and internal factors is the same for both experienced and inexperienced teachers.

### METHOD

**Subjects and Procedure:** Data were obtained from 94 secondary mathematics teachers who participated in the TIMSS-R. These teachers taught 8<sup>th</sup> graders during the school year 1998-99. Thirtyfive of them were males and 59 females. The sample was representative of the population of mathematics teachers in Cyprus with regard to experience and gender. The sample selection as well as the procedures for the questionnaire completion followed the guidelines provided by TIMSS-R.

**Instruments:** Data were collected using parts of the TIMSS-R teacher questionnaire, and the teaching efficacy questionnaire, which was developed by the authors. The following is a brief description of the variables used in the present study for measuring the internal factors and the teaching efficacy of teachers.

**Internal Factors:** In the present study we considered as internal factors the attitudes of teachers towards mathematics, their content knowledge and their pedagogical content knowledge. To measure teachers' **attitudes** 9 items were selected from TIMSS-R teacher questionnaire. These items elicit information

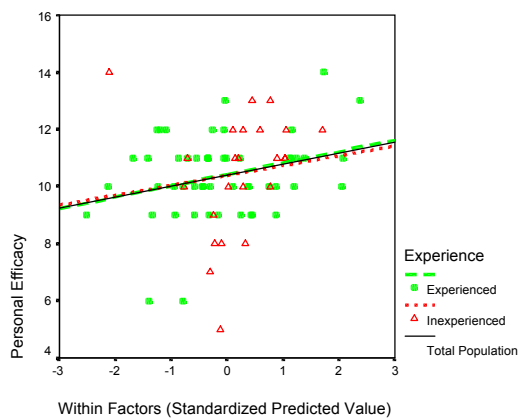
about teachers' conceptions of mathematics on the nature of mathematics, and the on process of teaching and learning mathematics. The **content** knowledge preparation of mathematics teachers was also represented by the total score of teachers' responses to 12 items in which they were asked to indicate the extent to which they feel well prepared to teach the curriculum content of mathematics in the 8<sup>th</sup> class. The **pedagogical** knowledge was measured using 20 items from the TIMSS questionnaire which provide information about the way teachers organize their classes, the type of questions and exercises they assign to students, the way they deal with students' problems, the type of homework they assign, and the weight teachers give to different types of assessment. The measures of **teaching efficacy** were obtained through a questionnaire specifically designed for the purposes of the present study. Respondents used a 6-point agree/disagree scale to respond to 13 statements which measured TE, 11 which measured PE, and 10 which measured OE. Three composite scores (TE, PE, and OE) were produced by adding the scores of the individual statements comprising each one. TE, PE and OE were the dependent variables for the subsequent analysis.

## RESULTS

The main assumption of the study was that experienced and inexperienced teachers matched on internal factors such as attitudes towards mathematics, content apprehension and pedagogical preparation do not differ substantially on their teaching efficacy beliefs. Therefore, it is important, first, to present the situation of teachers on these matched tasks, and then their feelings about TE, PE and OE. To this end, we conducted a repeated measures analysis, which showed that there were no statistically significant differences between the two groups on the tasks of internal factors (attitudes, content knowledge and pedagogical preparation). This result leads to the conclusion that both the experienced and inexperienced teachers, involved in the study, were matched on all internal tasks under consideration. The matching of both groups of teachers on the internal factors can be explained by the fact that mathematics teachers in Cyprus form a homogeneous group with respect to their qualifications, since the great majority of them are graduates of Greek universities, which mostly follow the same programs.

Following developmental theory's assumptions, we would expect that inexperienced teachers when matched to teachers of equivalent internal factor levels should perform equally well as experienced teachers on efficacy tasks. The results showed, however, that teachers in the two groups, although matched on internal factors, performed equally well on two of the three efficacy tasks, i.e. on the PE and OE efficacy beliefs but differed significantly on the TE. Non-experienced teachers ( $\bar{X}=15.36$ ) seem to believe that they are more successful on TE than experienced teachers ( $\bar{X}=14.28$ ). The latter difference is not sufficient to provide support for either the developmental or the difference theory.





**Figure 1:** The Regression of TE, OE, and PE of Experienced and Inexperienced Teachers on Internal Factors.

What is of greater importance is the relationship between efficacy and internal factors and not the disparity in the mean levels of TE, PE or OE, which in some cases can be explained by differences in other variables such as motivation, school system and climate, organizational structures, etc. According to difference models, the relationships between efficacy and internal factors are essentially different in the two groups. The developmental theory posits that the relationship of efficacy and internal factors in experienced and non-experienced teachers is not different from that observed for teachers in general. Therefore, the second hypothesis of this study refers to these relationships, which are explored through the regression analysis.

According to the design, the efficacy effect is a linear combination of parameter values of internal factors. To test this model multiple regression was used. Figure 1 presents the plots of the observed and predicted values for both groups of teachers. The regressions of efficacy beliefs on internal factors for teachers as a whole and the two groups (experienced and non-experienced) separately are indicated by the straight bold line and the dotted lines, respectively. As can be seen from Figure 1, the regression lines seem to coincide in the case of PE, while in the case of OE the regression lines of the two groups are almost parallel and very close to the line for total sample of teachers. The regression line of TE shows that non-experienced teachers reported higher feelings of TE than

experienced teachers, reaffirming the results of multivariate analysis. This result is not in contrast with the notion of development and thus, it can not be considered as supporting the difference model. However, in order to provide support to the developmental theory in this case, we need to examine whether the regression lines are homogeneous for both groups in TE, PE, and OE. The t-values for the difference between the line slopes of the two groups of teachers were quite smaller than the critical values in the t-distribution, leading to the conclusion that the slopes do not differ significantly. Thus the pattern of efficacy beliefs is homogeneous in experienced and non experienced teachers even in the case of TE where the means of the two groups of teachers differed significantly.

## CONCLUSIONS

In the present study we advocated for a different methodological approach to conceptual issues of teaching efficacy in the context of a new theoretical framework, that of developmental and difference theory. At present most of the studies placed excessive reliance on testing for group differences between experienced and inexperienced teachers' teaching efficacy. This study suggests a shift from group means to relationships among internal factors and teaching efficacy at specified experience levels. The main view expressed in this paper is that the line of regression should be the test for the developmental or difference models. If discrepant relationships between teaching efficacy and internal factors were apparent in comparisons between groups designated experienced and non experienced teachers, then support for the difference theory would be indicated. In the present study the comparisons of the slopes of the lines of experienced and inexperienced teachers demonstrated that TE, PE and OE beliefs develop in a similar continuous way, and thus the data provide support for the developmental theory.

The developmental theory of teaching efficacy implies that experience does not alone constitute a decisive factor that influences teaching efficacy. The role of experience is moderated by internal factors. Thus, the development of TE, PE, and OE was similar in both groups of teachers. However, differences between beginning and experienced teachers may exist, but the emphasis is on the relationships among the factors that contribute to teacher efficacy. Thus in the present study we first equated teachers on the internal factors, and we advocated that when teachers are matched on internal factors then the structure of teaching efficacy follows in an equivalent manner.

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