TOWARDS A UNIFIED MODEL ON TEACHERS' CONCERNS AND EFFICACY BELIEFS RELATED TO A MATHEMATICS REFORM

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Teachers' concerns and efficacy beliefs (EB) are important for the success of any reform. Previous research has shown that teachers' concerns develop in three levels: self, task and impact, respectively. Thus, this study examines the concerns and EB of primary teachers with respect to a reform concerning the use of Schema Theory in teaching problem solving (PS). A proposed model connecting teachers' EB and concerns is also tested. Analysis of data suggests that teachers' concerns were situated in the first level; teachers seemed to feel more efficacious in teaching PS without using the reform. Teachers' concerns were affected by their EB, which in turn, were affected by first-level concerns. Concerns of succeeding levels were also influenced by concerns of preceding levels. Implications of findings for the development of the reform policy and for further research are drawn.

INTRODUCTION

Following international trends, a reformed primary mathematics curriculum was introduced in Cyprus in 1998. One of the characteristics of the reform was the use of a model for solving problems, mainly based on Mashall's Schema Theory (1995). The model was in operation for the last five years, during which the teachers involved expressed contradictory evaluations about the practical usefulness of the model to enhance students' problem solving (PS) ability.

Research findings during the last two decades underlined the importance of examining teachers' reaction towards a reform; any change is associated with new demands on the part of the teacher and naturally the success of any reform effort depends highly on the teachers' role (Amit & Fried, 2002; Sztajn, 2003). Two research domains that have been studied excessively during the last three decades, i.e., teachers' concerns and teachers' efficacy beliefs (EB) are nowadays revisited and connected to teachers' attitudes towards the implementation of a reform, as well to each other. Research has shown that these constructs influence teachers' attitude towards a reform and their attempts to implement it (Tschannen-Moran, Woolfolk-Hoy & Hoy, 1998; Piggie & Marso, 1997).

Fuller introduced the concept of teachers' concerns in the late 1960s (van den Berg & Ros, 1999) and put forward a classification of teachers' concerns consisting of three developmental levels, namely self, task and impact concerns. Self-concerns mainly relate to the teachers' anxiety about their ability to take over the new demands in the school environment, task concerns refer to the daily duties of a teaching job, especially in relation to a number of limitations such as time constraints, teaching a large number of students or the lack of resources. Finally, impact concerns deal with

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teachers' apprehension concerning students' outcomes. Incorporating Fuller's conceptualization, the Concerns Based Adoption Model (CBAM) (McKinney, Sexton & Meyerson, 1999) identifies seven stages of concerns: awareness, informational, personal, management, consequences, collaboration and refocusing. The first three stages constitute self-concerns, the fourth relates to task concerns and the three latter represent impact concerns. According to the model, initially teachers have little knowledge of the innovation (awareness); later on, they are concerned about their ability to respond to the requirements of the reform (personal) and they show their willingness to learn more about it (informational). Self-concerns gradually decrease and teachers focus on managing the reform (management). Finally, teachers overcome tasks concerns and focus upon the effects of the reform on students' learning (consequences) and seek for cooperation with their colleagues (collaboration); they also make suggestions for improvements regarding the reform (refocusing). Though there was evidence about the developmental nature of teachers' concerns (e.g., van den Berg & Ros, 1999; Piggie and Marso, 1997), to the best of our knowledge, no systematic attempt has been undertaken to test the assumptions of the CBAM.

The construct of efficacy beliefs (EB) was initiated in the 1970s and refers to one's ability to plan and execute actions to achieve a goal (Bandura, 1997). EB were found to exert great influence in adopting and implementing an innovation; teachers possessing high EB harbor more positive attitudes towards the innovation, are more likely to implement it and regard it as important and compatible with their traditional way of working (Tschannen-Moran et al., 1998). Moreover, these teachers are more willing to experiment with new teaching approaches and materials, and are less anxious about the reform and the possible limitations or complications deriving from it (Bandura, 1997).

Recently, research has employed both these concepts to study the implementation of a reform; it has been shown that there is an interaction between teachers' EB and their concerns about the reform. Specifically, teachers with low EB have been found to display intense self and task concerns compared to their high efficacious colleagues (Ghaith & Shaaban, 1999). Moreover, the more efficacious teachers are feeling regarding the innovation, the more intense are their impact concerns (McKinney et al., 1999). It has been also found that teachers' concerns are largely affected by their EB (Christou, Philippou, Pitta-Pantazi & Menon-Eliophotou, 2002). However, researchers have moved only in one direction focusing on the extent to which EB affect teachers' concerns. It can be claimed that teachers' concerns, especially those related to awareness about the reform, may influence their level of EB. This assumption is based on the fact that research reveals that teachers' knowledge in a specific domain influence their efficacy in teaching subjects related to this domain (Wenner, 2001).

In the light of the above, the purpose of this study was twofold. It aimed to examine teachers' concerns and EB in teaching PS by using the reform model and to develop a

model connecting teachers' EB and concerns. Specifically, three hypothesis were tested: (a) teachers' concerns can form a hierarchical model (awareness, informational, personal, management, consequences, collaboration and refocusing), with preceding stages affecting teachers' concerns in subsequent stages, (b) EB affect teachers' second and third level concerns (task and impact concerns), while they are affected by their first level concerns, and (c) teachers' EB about employing approaches used prior to the reform, affect their concerns about the reform.

METHODS

Stratified sampling was used to select 27 (rural and urban) primary schools in Cyprus. Since the new PS model is introduced in the fourth grade, and employed henceforth, the teachers of the aforementioned schools who were teaching at the three upper grades completed a questionnaire of 52 items on a nine point Likert scale that reflected their concerns and EB as regards the specific reform. Specifically, was used. Thirty-seven items derived from the Stages of Concerns included in the CBAM, translated in Greek and reworded to reflect the characteristics of the specific reform; the remaining 15 statements referred to teachers' EB. Responding to the need to increase the specificity of efficacy items (Nielsen & Moore, 2003), statements were developed to measure teachers' EB in teaching PS either by using the new model or by employing traditional strategies used prior to the introduction of the reform. The response rate (90.4%) was very high, since 151 out of the 167 teachers completed the questionnaires.

The data were initially analyzed through exploratory factor analysis, which identified non-directly observable factors based on teachers' responses. Structural equation modeling was next employed to test the hypotheses of the study. Maximum likelihood method was used to estimate the model parameters, since this method does not require data from extremely large samples (Kline, 1998). More than one fit index was used to evaluate the extent to which the data fit the models tested. Specifically, the scaled chi-square, Bentler's (1990) Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA) (Brown & Mels, 1990) were examined.

FINDINGS

Exploratory factor analysis resulted in a seven-factor solution explaining 62.45% of the total variance. The seven factors were related to teachers' EB and concerns and were identical to those mentioned in the specification table of the questionnaire. This finding provides support to the construct validity of the questionnaire used to collect data on teachers' EB and concerns about the reform (Cronbach, 1990). Thus, factor scores for each dimension were estimated, by calculating the average of the items that comprised each factor. The mean scores, the relevant values of standard deviations and Cronbach's alpha values for each factor are presented in Table 1.

No	Factors	$\bar{x}$*	SD	A
	Factors related to teachers' EB			
1.	EB in teaching PS without using the model.	7.74	0.94	.77
2.	EB in teaching PS by using the model.	6.49	1.46	.92
	Factors related to teachers' concerns:			
1.	Need for Information.	6.73	1.70	.81
2.	Awareness	5.51	1.81	.81
3.	Refocusing-negative criticism towards the model.	5.37	1.93	.87
4.	Consequences on students	5.11	1.86	.89
5.	Management	4.70	1.47	.69

* In a 9 point-scale (1=negative and 9=positive)

Table 1: Means, Standard Deviations, and Cronbach's alpha coefficients of the seven factors identified by exploratory factor analysis.

Table 1 shows that the values of Crobach's alpha of six factors are relatively high (i.e. ranging from .77 to .92). This implies that the measurement errors of these six scales are relatively low and thereby the collected data on the six factors can be considered reliable. On the other hand, the reliability of the "management" factor is moderate satisfactory (.69). Nevertheless, this can be attributed to the procedure used to estimate Cronbach's Alpha, which is highly dependent on the number of items of each scale (Norusis, 1993). Thus, the low value of the Cronbach Alpha of this scale is partly due to the fact that only four questionnaire items were used to measure this factor. Table 1 also suggests that teachers' level of EB (either by using the model or without it) was quite high. However, the paired t-test revealed that their EB in teaching PS without using the reform model were significantly higher than their corresponding beliefs in using the reform ($t=10.40$, $df=136$, $p<.001$). Table 1 also shows that teachers experienced intense concerns related to the level of the information they have received about the reform. Though teachers adopted a rather critical approach to the model ($\bar{x}=5.37$), in general this opinion was not strong enough, since its standard deviation was relatively high (SD=1.93). Similarly, concerns about the consequences of the model on pupils and the management of the reform appeared moderate. In general, it can be argued that five years after the introduction of the reform, teachers' concerns were mainly situated in the first level of concerns (awareness and information).

Kendall's test was subsequently employed in order to rank the different types of teachers' concerns, based on the level of their intensity. Specifically, the Kendall Coefficient of Concordance was calculated and revealed a significant level of agreement among teachers about the intensity of different types of concerns ($w=.21$, $p<.001$). Informational concerns were placed at the "intense" end of the scale (mean rank, $mr=4.16$), along with the concerns reflecting teachers' awareness of the reform ($mr=3.15$). The refocusing concerns were somewhere in the middle ($mr=2.86$), while at the least "intensive" end one could identify teachers' concerns regarding the consequences on pupils ($mr=2.45$) and managing the reform ($mr=2.38$).

The factor scores of the seven factors identified above were also employed to search for the relationships between teachers' concerns and EB, using the EQS (Bentler, 1995). As reflected by the iterative summary, the goodness of fit statistics showed that the data did not fit the model very well (x^2=14.12, df=6, p<.03; CFI=.978, and RMSEA=.170). Subsequent model tests revealed that the model fit indices could be improved by adding another path joining management concerns and refocusing. The model that emerged after this modification had a very good fit to the data (x^2=8.25, df=7, p>.23; CFI=.997 and RMSEA=.036). Figure 1 shows the model that emerged, as well as the path coefficients among the seven factors. The following observations arise from Figure 1. First, teachers that held high EB to teach PS without using the model tended to support that they had received more information regarding the reform. On the other hand, the more aware teachers were about the reform, the higher their EB were to teach by using the model. Teachers' EB to teach PS by using the reform were also explained by their efficacy to teach PS without using the model. Second, the more aware teachers were about the reform, the lower their need was to get more information as regards the underlying theory, philosophy and aims of the reform.

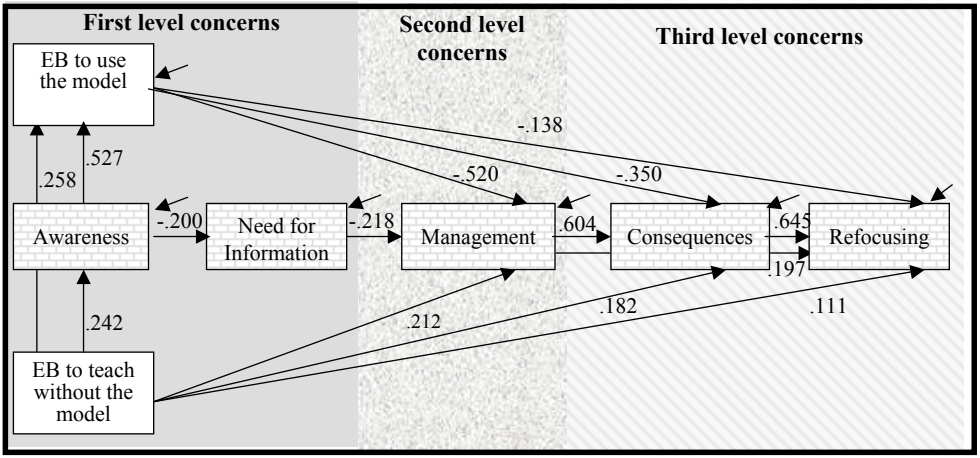

Figure 1: Path model of the seven factors linked to teachers' efficacy beliefs (EB) and concerns regarding the implementation of the problem solving reform.

Third, teachers' second level concerns (management concerns) were explained both by their concerns of the preceding stage as well as by their EB. Namely, teachers who supported that they had received a satisfactory level of information regarding the reform, and who reported a high level of efficacy to teach PS by using the model were less concerned about issues related to managing the reform. On the contrary, teachers who conceived themselves as highly efficacious in teaching PS without using the model were highly concerned regarding the management of the reform.

Fourth, teachers' third level concerns were explained by their second level management concerns as well as by their EB. Specifically, teachers that harbored high EB in teaching by using the reform, low EB in teaching PS by employing approaches used prior to the introduction of the reform and who reported low concerns regarding the management of the model were less concerned about the consequences of the reform on pupils. It should also be noted that management concerns explained more variance of teachers' concerns about the consequences of the reform on pupils than their EB to teach PS either by using the model or without it. The same pattern was also identified in the case of refocusing concerns, though, in a revered order. Namely, the more efficacious teachers tended to be in teaching PS without the model and the least efficacious they felt in using the model, the stronger they supported the need to abolish the model and resort to previously used PS teaching approaches. Moreover, even though management and refocusing concerns did not appear subsequently, the higher teachers' concerns were regarding the management of the reform, the more they were disfavor of the reform.

In general, the model of Figure 1 verified the three examined hypotheses: The factors related to concerns were found to form a hierarchical model, with every preceding stage explaining a proportion of the variance of the subsequent stage. On the other hand, EB affected teachers' second and third level concerns. Finally, teachers' level of awareness was found to influence their EB to teach PS by using the reform, whereas these concerns were affected by teachers' EB to teach PS without using the model.

DISCUSSION

The findings of the study reveal that even five years after the implementation of the reform Cypriot teachers mainly exhibit self-concerns. Namely, teachers were more concerned about the level of their awareness about the reform; thereby they expressed intense concerns about the need to receive more information about the reform. This finding is in line with previous research suggesting that self-concerns are not quickly solved and that it may take three to five years before teachers move from this level of concerns to the next one (van den Berg & Ros, 1999). Teachers were also found to harbor relatively positive EB about PS, either by using the model or by resorting to teaching strategies used prior to the introduction of the model. This finding seems reasonable, taking into account the emphasis given to PS in Cyprus (Charalambous, Kyriakides & Philippou, 2003). However, it should be recognized that teachers harbored a higher level of EB in teaching PS without using the model, justifying previous findings (Fullan, 1991; Ghaith & Shaaban, 1999) according to which teachers feel more efficacious in using tested and tried methods than employing innovative approaches in their teaching.

The present study also provided support to the assumption that the various stages of teachers' concerns can form a hierarchical model, since it was found that teachers' concerns in succeeding stages were influenced by their concerns in preceding stages. However, the path connecting management and refocusing concerns identified in the

study supports that teachers might simultaneously experience concerns of different levels. This is in line with recent findings (Burn, Hagger, Mutton & Everton, 2003) and raises doubts about the existence of a developmental scale able to discriminate teachers in distinct stages of concerns. Further research could elaborate more on this assumption, testing the possibility of placing teachers into different levels representing a mixture rather than discrete concerns. Specifically, item response theory models could be used to examine the separability of the person estimates scale (Charalambous et al., 2003).

Moreover, the study illustrated the important role of EB in the implementation of a reform. Teachers holding higher EB in using the reform model were found to experience less worries about issues related to the management of the reform and the influence of the reform on students' achievement; they were also less critical about the reform. It should be noted, though, that teachers' efficacy was affected by their level of awareness about the reform, indicating that a first step in developing teachers' efficacy is to provide them ample information about the philosophy and aims of the reform. In the present study a new element was also added to the efficacy and concerns model, i.e., teachers' efficacy in using strategies employed before the introduction of the reform. This type of teachers' efficacy exerted the same influence on their concerns, but in a reversed way, suggesting that teachers who feel efficacious to teach by using certain teaching strategies criticize a reform more and foresee more problems as a result of its implementation. In sum, the findings of this study are in line with previous findings showing that EB are important factors to be considered in efforts to initiate and sustain educational change (Mc Kinney et al., 1999).

In the light of the above, policy makers could try to improve teachers' awareness about the reform, by providing them ample information related to it. By doing so, they make the first step to advance teachers' efficacy, which subsequently may help teachers envision fewer problems when requested to implement a reform and make them less critical to it. Reacting positively towards a reform is indeed important, taking into account teachers' resistance to mathematics reforms (Amit & Fried, 2002). It should be finally indicated that future research needs to cross-validate the model that emerged from the present study, both by looking at different forms of changes in mathematics and by collecting data in different educational settings.

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