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ABSTRACT

This investigation traced changes in anxiety for teaching mathematics (ATM) among pre-service elementary school teachers (n=36) enrolled in a mathematics methods course by analyzing their weekly journal entries. Journal entries were coded for high level of ATM (ATM-high) or absence of ATM (ATM-absent) during the first class session, as well as high level or absence of ATM and classroom context throughout the semester. Results of analysis of initial ATM-high (n=8) and initial ATM-absent (n=8) journal entries found variability in ATM levels among both groups throughout the semester. Initial ATM-absent pre-service teachers consistently reported high levels of interest in teaching mathematics. Similarly, when those reporting high initial ATM described interest in developing creative strategies for teaching mathematics, their ATM was reduced. For initial ATM-high pre-service teachers, when ATM became severe during the semester, it interfered with learning new course material. Implications for developing mathematics methods course curriculum are discussed. (Author)

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Abstract

The present investigation traced changes in anxiety for teaching mathematics [ATM] among pre-service elementary school teachers (N=36) enrolled in a mathematics methods course by analyzing their weekly journal entries. Journal entries were coded for high level of ATM [ATM-high] or absence of ATM [ATM-absent] during the first class session, as well as high level or absence of ATM and classroom context throughout the semester.

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Variability in Anxiety for Teaching Mathematics Among Pre-service Elementary School Teachers Enrolled in a Mathematics Methods Course

Pre-service elementary school teachers frequently experience mathematics anxiety (Hembree, 1990) as well as anxiety for teaching mathematics [ATM] (Levine, 1993; in press). Hembree (1990) concludes a review of the mathematics anxiety literature by defining school-related mathematics anxiety as "a general fear of contact with mathematics, including classes, homework, and tests" (p.45). Anxiety for teaching mathematics, a frequent fear of pre-service teachers, is associated with teaching mathematics (Levine, 1993). ATM may reflect real or perceived knowledge deficits in mathematics content as well as in teaching skills, and memories of past occurrences of mathematics failure or mathematics anxiety (Levine, 1993).

Although anxiety is often assumed to be a linear phenomenon, recent research suggests that it is dynamic and may change over time. In addition, anxiety level may affect and be affected by subsequent experience (Meece, Wigfield, and Eccles, 1990; Pekrun, 1992). The present investigation traces changes in ATM among pre-service elementary school teachers enrolled in a mathematics methods course.

Method

Subjects

Pre-service elementary school teachers (N=36) enrolled in a graduate level course concerned with methods and materials of mathematics instruction participated in this study. Focal to the course were approaches to teaching mathematics consistent with current National Council of Teachers of Mathematics (NCTM) recommendations (1989, 1991). In addition, participant attitudes and feelings about teaching mathematics were frequently discussed.

Procedure

To record changes in ATM and its effects, participants were asked to write journal entries following each class meeting as part of the course requirement. To encourage accurate and honest recording of the thoughts and feelings of the writer, assurance was given that no journal would be read prior to final grade assignments. Thus, for the purpose of this investigation, a non-interactive journal was required. The journal assignment was structured to require that participants include content discussed in class as well as each participant's reaction to the material. No explicit request was made for participants to include self-reported levels of anxiety.

Journal entries were coded for high level of ATM [ATM-high] or absence of ATM [ATM-absent] during the first session, as well as high level or absence of ATM and classroom context throughout the

semester, by two trained coders. Agreement reached 100% on high level or absence of ATM in the first journal entry. In this way, shifts in ATM, mediating factors, and related performance characteristics were traced. Initial ATM levels varied among participants. Those initially (i.e., during their first entry) indicating either ATM-high (N=8) or ATM-absent (N=8) were selected for analysis.

Results

Journal entries of those pre-service teachers coded as initial ATM-absent were analyzed separately from those coded as initial ATM-high.

Initial ATM-Absent

Journal entries of pre-service teachers who were coded as having no initial ATM included statements indicating both confidence and interest in the coursework. However, ATM was reported in each participant's journal entries at some time during the semester. Four pre-service teachers reported ATM regarding the completion of course requirements during the second session, focused on specific assignments (e.g., developing a lesson plan, preparing materials for teaching mathematics, creating student-centered lessons). Along with ATM, two pre-service teachers reported high interest and excitement in anticipation of learning these skills. A constructivist framework for teaching mathematics,

discussed during the second session, coincided with the ATM reported. This conceptualization of how mathematics is learned was new for most pre-service teachers and may have contributed to ATM. Similarly, ATM was reported regarding ability to construct a quality lesson plan in two journal entries following session four, the session when the first draft of the lesson plan was due.

Specific mathematics content did not generate ATM among this group of pre-service teachers. Using manipulative materials to teach concepts underlying mathematical operations was different from the procedural focus of learning mathematics during their elementary school experience and facilitated their conceptual understanding. However, interpreting the meaning of division of fractions was related to ATM for four pre-service teachers. Despite ATM, they expressed interest in the mathematical process.

One pre-service teacher reported ATM anticipating that personally stressful situations would interfere with her ability to learn to teach mathematics in a satisfactory manner. This concern appeared three different times in her journal, including discussion concerning one missed class due to an asthma attack.

Initial ATM-High

All pre-service teachers who were coded as having high ATM levels during their first journal entry exhibited the same pattern: ATM level remained high for several sessions, disappeared or was reduced during the middle of the semester, and reappeared at the

end of the semester.

Initial ATM-high was attributed to concern regarding mastering appropriate teaching strategies (N=5) or a history of inadequate mathematics knowledge and unpleasant experiences related to learning mathematics (N=3). Second journal entries recorded ATM anticipating one's inability to learn specific instructional strategies or demonstrate mastery of content material through completion of specific course assignments, such as acquiring effective questioning techniques, developing a material to teach a mathematics concept, or completing a written ungraded computation diagnostic task.

One pre-service teacher expressed anxiety about learning mathematics teaching strategies, particularly the development of a mathematics teaching material. She reported ATM during a class discussion in which students generated and interpreted Venn Diagrams. During this discussion, she found it difficult to communicate her thoughts about the topic. During another session, she was not anxious while developing word problems in small groups or renaming fractions using fraction pieces. However, she again became confused and anxious when students discussed multiplication and division of fractions. Thus, abstract discussions about mathematics concepts increased her ATM, while access to manipulative materials that enabled her to understand concepts reduced her ATM.

Another pre-service teacher, initially ATM-high because she anticipated difficulty learning mathematics teaching strategies, reported anxiety during every session for the first half of the semester. Meeting course requirements, confusion during content-specific class discussions (e.g., identifying rules for the Roman system of numeration, interpreting subtraction), and participating in group activities generated anxiety. Despite the dual challenge to both relearn forgotten mathematics concepts and learning teaching strategies, she did not record anxiety during the second half of the semester. Thus, engagement in learning and teaching mathematics appeared to reduce her anxiety.

Two pre-service teachers, initially reported ATM because of their inability to develop effective teaching strategies. Throughout the semester, they expressed interest in the many mathematics topics introduced. Only developing teaching strategies for the fraction relationships were related to their anxiety at the end of the semester.

The self-imposed isolation of one pre-service teacher who consistently created original strategies and materials for teaching mathematics contributed to her ATM. When she actively participated in class and group discussions her ATM decreased. One pre-service teacher, whose high initial ATM resulted from her childhood history of unsuccessful mathematics experiences and her current difficulty understanding the assigned textbook readings, indicated that her exposure to creative strategies for teaching mathematics

discussed in class reduced her anxiety, perhaps because there was no expectation of prior knowledge or success with these strategies. She also indicated that the clearly stated course objectives and student-centered class discussions relieved some of her anxiety. Thus, for example, although anxious about writing a lesson plan, she expressed satisfaction with the one she handed in.

Another pre-service teacher, who was initially anxious because of her weak mathematics history, viewed this course as an opportunity to re-learn mathematics concepts. Her prior professional experience in a design career enabled her to enjoy using manipulative materials to teach concepts and stimulated her imagination to develop novel teaching strategies. This participant reported ATM at the end of the semester due to her awareness of the difficulty she experienced choosing appropriate language to teach mathematics concepts.

The eighth pre-service teacher reported high levels of ATM resulting from her history of poor achievement in mathematics. Exposure to strategies for introducing mathematics concepts using manipulative materials and learning to develop a lesson plan, while generating uncertainty, reduced her ATM. During the fifth class session she reported "not feeling bad for not knowing the answer," which was a novel experience. However, she did become anxious during the eighth and ninth sessions. During the eighth session, while properties of prime numbers were discussed, she was flooded with a childhood memory of humiliation and physical assault when a

teacher threw an eraser at her in the elementary school classroom for not knowing the answer to a mathematics problem involving prime numbers. During the present experience, she was unable to concentrate on the material being discussed. The ninth session began with an activity during which participants were asked to identify a relationship among the fraction pieces on their desks. This participant reported panicking when her turn came because her identified relationship had been stated earlier. Feeling anxious and helpless, she was unable to respond. The following week, she reported that initially she was embarrassed because she had been unable to respond the previous week. This embarrassment prevented her from participating in the class discussion. However, she eventually became engaged in the content of the current session. She did not report feeling anxious during the remaining class sessions. Thus, this participant demonstrated that a pervasive anxiety experience attributed to unsuccessful and humiliating experiences as an elementary school student could continue to interfere with one's current ability to learn new mathematics.

Discussion

Results of this analysis found variability in levels of anxiety for teaching mathematics among pre-service elementary school teachers throughout the semester. Different patterns emerged for initial ATM-absent and ATM-high participants.

Initial ATM-absent pre-service teachers consistently recorded high levels of interest in teaching mathematics. The introduction of specific topics (e.g., division of fractions) and new teaching strategies (e.g., using manipulative materials, writing lesson plans) generated ATM. However, interest in the material, and belief in their ability to succeed and understand the material accompanied most ATM statements. Similarly, when initial ATM-high pre-service teachers described interest in developing creative strategies for teaching mathematics their ATM also was reduced.

For initial ATM-high pre-service teachers, when ATM became severe during the semester, it interfered with learning new course material. This is consistent with the findings of Meece, Wigfield, and Eccles (1990) and Pekrun (1992) that anxiety level may affect and be affected by subsequent experience. Moreover, this finding suggests that pre-service teachers who experience ATM may be less able to learn and create material related to teaching mathematics. While extreme levels of anxiety may disrupt cognitive and attitudinal processes, moderate levels of anxiety may improve performance and motivation to succeed (Heinrich and Spielberger, 1982; Wine, 1980).

Among initial ATM-high pre-service teachers classroom activities created anxiety. Recognition of differential responses to an activity depending on anxiety level can be used to influence curriculum development in a methods course. Recommendations for reducing anxiety for teaching mathematics include helping students

acknowledge and identify personal histories with respect to mathematics, structuring activities so that they are well-defined yet offer opportunity for creative expression, varying tasks as well as group composition and size to encourage maximum expression of ideas among as broad a community as possible, and anticipating and acknowledging variations in levels of anxiety throughout the semester.

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