Abstract: The central purpose of this chapter is to demonstrate that by coordinating sociological and psychological perspectives we can explain how changes in beliefs might be initiated and fostered in mathematics classrooms. In particular, we examine: 1) the coordination of students’ beliefs about mathematical activity and classroom social norms and 2) the coordination of specifically mathematical beliefs and classroom sociomathematical norms. Examples from a university level differential equations class are used for purposes of clarification and illustration.

1. INTRODUCTION

For more than a decade we and our colleagues have collaborated to study students’ mathematical learning in the context of the classroom. In the process of doing so, we have developed an interpretive framework (see Table 1) for analyzing classrooms that coordinates both individual (psychological) and collective (sociological) perspectives. In this work we were strongly influenced by Bauersfeld, Krummheuer, and Voigt’s (Bauersfeld, 1988; Bauersfeld, Krummheuer, & Voigt, 1988) long standing work in advancing symbolic interactionism as a theoretical framework for investigating mathematics teaching and learning. The central thesis of this chapter is that by coordinating sociological and psychological perspectives it is possible to develop ways to explain how changes in beliefs might be initiated and fostered in mathematics classrooms. The purpose of this chapter is to develop this thesis. In particular, we discuss those aspects of the interpretive framework that relate to student beliefs and the corresponding classroom norms. The beliefs we consider in this chapter are beliefs about one’s role, others’ roles, and the general nature of mathematical activity in school and specifically mathematical beliefs and values. We use a university level differential equations class as an example to clarify and illustrate these constructs within the framework. The example demonstrates both the normative aspects of the classroom and the corresponding student beliefs. In each of the classrooms we have studied over the past years, from elementary school mathematics to university level differential equations, student mathematical beliefs changed dramatically over the course of the teaching experiment. In this chapter we demonstrate how the theoretical constructs of the interpretive framework can be used to explain this change. The significance of this work is that it begins to address...
a major challenge in working with beliefs, namely, the initiation of changes in students’ beliefs about mathematics and mathematics instruction (also see Greer, Verschaffel, & De Corte, this volume; Tsamir & Tirosh, this volume).

2. BACKGROUND

Following on the seminal work of Erlwanger (1973), a number of mathematics educators have argued for the need to consider students’ beliefs about mathematics when attempting to make sense of their mathematical behavior. For example, Cobb (1985) demonstrated that the mathematical activity of the young children who participated in an extended teaching experiment could not be accounted for solely in terms of their mathematical conceptions. However, by complementing a conceptual analysis with an analysis of the children’s beliefs it was possible to explain the radically different behavior of children to whom similar concepts were attributed. At the same time, Schoenfeld’s work with university level students led to similar conclusions (Schoenfeld, 1983).

As early as 1986, Cobb conjectured that mathematics instruction, as a socialization process, influences student beliefs (see also Greer, Verschaffel, & De Corte, this volume). This conjecture, which was based on working with children in one-on-one settings, was confirmed in a classroom teaching experiment we conducted in 1986-87 in one second-grade classroom. As we have reported elsewhere (Cobb, Yackel, & Wood, 1989), student beliefs at the beginning of the school year were compatible with a “school mathematics tradition,” but as the year progressed their beliefs became compatible with an “inquiry mathematics tradition”. Initially,

[T]he teacher’s expectations that the children should attempt to construct their own solutions to problems and verbalize how they actually interpreted and attempted to solve the instructional activities ran counter to their prior experiences of mathematics instruction in school (Wood, Cobb, & Yackel, 1988). The teacher, therefore, had to exert her authority in order to help the children reconceptualize their beliefs about both their own roles as students and her role as the teacher during mathematics instruction. She and the children initially negotiated obligations and expectations at the beginning of the school year which made possible the subsequent smooth functioning of the classroom. Once established, this mutually constructed network of obligations and expectations constrained classroom social interactions in the course of which the children constructed mathematical meanings (Blumer, 1969). The patterns of discourse served not to transmit knowledge (Mehan, 1979; Voigt, 1985) but to provide opportunities for children to articulate and reflect on their own and others’ mathematical activities. (Cobb et al., 1989, p. 126)

As we will explain below, in order to investigate how it was that student beliefs were influenced by the socialization process, we sought to analyze the social (participation) structure of the classroom. The sociological perspective we followed was that of symbolic interactionism because of its compatibility with psychological constructivism (Voigt, 1996; Yackel & Cobb, 1996). In the same way that attention to student beliefs is not a logical necessity but proves pragmatically useful because it helps to account for aspects of students’ mathematical activity that otherwise are not explainable, taking a sociological perspective is not a logical necessity. However,