

CHAPTER 5

THE PHENOMENOLOGY OF THE MATHEMATICS CLASSROOM

This chapter's primary purpose is to offer some preliminary work in theoritising the individual learner's perspective in mathematics lessons within a model derived from Schütz's seminal work in social phenomenology (for example, 1962, 1967). Here, the mathematics classroom is seen as an environment of signs, comprising things and people, which impinge on the reality of the individual student (cf. Brown 1996 c). The chapter introduces a framework through which mathematical work is seen as taking place in the imagined world through the filter of the world in immediate perception. This provides an approach to structuring evolving mathematical understanding. It is suggested that mathematical ideas are contained and shaped by the student's personal phenomenology, which evolves through time. Further, I argue that these ideas are never encountered directly but rather are always met through a circular hermeneutic process involving the reconciliation of expectation with experience.

In particular, I examine Schütz's framework used in describing how an individual experiences their world, as an approach to understanding how the student experiences the mathematics classroom. The focus in this paper is on the socio-cognitive aspects of learning mathematics seen from the individual learner's perspective as he builds an understanding of mathematics. Seeing a student as an insider of a particular way of life, I employ this perspective as a basis for offering a description of the process through which he develops mathematical ideas. It is this perspective that will be used as a home base in this enquiry rather than any sort of mathematical framework. That is, we shall concern ourselves with the task of the novice as he sees it, moving from a state of relative naivete, without the benefit of the expert mathematician pinpointing for us the mathematical objective governing the teacher's intention. From the outset this chapter should be understood as a one-sided enterprise, focusing on the insider point of view. In line with radical constructivist philosophy I will not be relying on such an expert overview of mathematics overseeing the students' work, since this is not available to the learner. In this particular chapter I will be proceeding *as if* there is no "independent, preexisting world outside the mind of the knower" (Lerman, 1989, p. 211), where mathematical phenomena can only ever be perceived from

particular positions and perspectives by observers with individual interests, from specific historically and culturally determined backgrounds. Whilst certain perspectives presuppose a social plane capable of producing a social view, social phenomenology focuses on the individual's experience of this social plane.

In this chapter I examine an approach to describing how individual students create mathematics in the physical and social situation they inhabit. Mathematical activity is seen as mediating access by the individual to any supposed externally defined objective mathematics. Extending an earlier metaphor, I suggest that their task is to identify (or even build) the furniture as well as find their way around it. Conventional views of mathematical phenomena are not presupposed, nor are physical embodiments of mathematical ideas seen as transparent (cf. Voigt, 1994, pp. 172-176). Rather, I build a framework for describing how these phenomena develop in the mind of a student, through time, in relation to that seen in immediate perception. I suggest that the student faces a whole variety of things and people which hold his attention in different ways. The characteristics and relative importances of these things, as perceived by the student, evolve through time and, in due course, some of these may be treated as "mathematical" as they are seen to be displaying particular qualities. However, even in work presented as "mathematical" to students by teachers, the mathematical qualities are not necessarily immediately apparent for the student. This chapter focuses on a theoretical framework for describing mathematics which accommodates the shifts in form and meaning that mathematical notions undergo in the mind of the individual. The influence of the work of Goffman (1975) and Schön (1983, 1987) and their notions of *frame* and *re-framing* will be evident in my discussion.

In the first part I introduce the notion of "personal space"; the space in which an individual sees himself acting. This is derived from Husserl's Cartesian phenomenology and developed in relation to Schütz's extension of this work. I show how it can provide a model for describing how students proceed through the classroom environment of phenomena towards establishing mathematical sense. Mathematical ideas are seen as developing for the individual within activity, where activity is seen as being "held in" by various kinds of constraints; imagined or real, seen or unseen, some imposed by the teacher, some by other students, some by the physical environment and some by the student herself. As such, his world is captured in an evolving phenomenological frame, where

there is a mutual dependency between the overarching frame and the components within it. The effect of these various constraints on an individual student depends on how he interprets and responds to them. The negotiation of these very constraints and the identification of the components of this space result in mathematical ideas being shaped in the mind of the individual. I seek to illustrate this process with an example of some students working on a mathematics task where the notion of “the line of symmetry” is seen as being embodied in some physical apparatus distributed to the children.

In the second part I introduce Schütz’s theoretical structure. This model provides a framework for differentiating between the world as seen in immediate perception and the world as interpreted as a space for action (physical or mental). I also demonstrate how this provides a useful mechanism for structuring time and change. Following this model I suggest that the individual acts in the world he imagines to exist. I further suggest that mathematics resides in this imagined world and is in an interactive relation with the world of surface appearance. I develop this discussion in relation to the lesson on symmetry and show how the physical apparatus employed in this lesson can be seen as anchoring, although not determining, the students’ mathematical constructions.

In the third part, I develop the discussion by proposing a mismatch between the individual’s expectations and experience. Whilst the individual might (voluntarily) act in the world as they imagine it to exist, the world may resist these actions in an unexpected way (involuntary response) and so cause a shift in the way in which an individual perceives the world. This extends to the individual’s use of a mathematical idea. In this process I suggest that the individual never reaches a final definitive version of any mathematical idea, but rather, is destined to be always working with his most recent version.

PERSONAL SPACE

In a classroom situation each person is acting according to how the world appears to him. In this section I focus on the student’s insider view of his classroom situation. I wish to introduce a notion of *personal space*, an extension of that which Schütz (1962, p. 224) calls the *world within reach*;

the stratum of the world of working which the individual experiences as the

kernel of his reality.... This world of his includes not only Mead's *manipulatory area* (which includes those objects which are both seen and handled) but also things within his view and the range of his hearing, moreover not only the realm of the world open to his actual but also the adjacent ones of his potential working. Of course, these realms have no rigid frontiers, they have their halos and open horizons and these are subject to modifications of interests and attentional attitudes. It is clear that this whole system of "world within my reach" undergoes changes by any of my locomotions; by displacing my body I shift the centre O of my system of coordinates, and this alone changes all the numbers (coordinates) pertaining to this system.

So viewed, the notion "personal space" leans firmly on Cartesian notions as developed by Husserl. A unified subject is implied; a thinking subject who therefore is (Descartes' "cogito ergo sum"). This is an idea treated with a certain disdain by post-structuralist writers insofar as it supposes any "completed and finished identity, knowing always where it is going" (Coward and Ellis, 1977, pp. 108-109). As I have indicated Derrida would reject the binary opposition between individual and social perspectives. Lacan (1977, pp. 1-7), meanwhile, stresses the importance of Descartes' notion, but places much more emphasis on the formation of the thinking subject in the reflexivity of the thinking done. Nevertheless, the thinking subject may not be aware of this theoretical perspective on his actions and so assumes he has more control over his own destiny than may be supposed in more post-structuralist formulations. It is this personal perspective I wish to examine now (cf. Brown and Jones, 2001).

In my formulation I incorporate the accents and emphases the individual places on the elements he perceives to be forming in this space according to his particular phenomenological frame; that is, the way in which the individual carves up his own particular perceptual field. Such a frame is consequential to the "biographically determined position" and current motives of the individual, which taken together form what Schütz calls the individual's *interest*. (Schütz, 1962, pp. 76-77; Goffman, 1975, pp. 8-9). This notion is akin to someone having an "interest" in a business - an interest which governs that person's actions in respect of the business. It is through this interest that various associations give rise to phenomena not in immediate perception. This interest also motivates the individual's will to act. Habermas (1972) sees knowledge in general as being flavoured by the interests it serves -

a notion pertinent to what follows here. Such an interest may be, for example, a student's desire to solve a particular mathematical problem as quickly as possible so as to satisfy his teacher. This could be qualitatively different to the interest of someone wishing to solve a problem for its own sake and seeking to understand the experience of being "inside" a mathematical problem (cf. Mason, 1992).

The personal space of any individual also incorporates some concern about other people sharing the social situation and how these people contribute to the perceived constraints. This concern may be about the way in which they impinge on the physical space, or be more directly about social interactions. This is discussed fully by Schütz (1967, pp. 97-207, 1962, pp. 312-329). Schütz's analysis is based on an individual society member "guided by the system of typical relevances prevailing within our social environment", who assumes he uses language in much the same way as everyone else (1962, pp. 327-328). He is cautious about the objective character of the reality of which he speaks. Goffman (1975, pp. 4-5) pinpoints this:

We speak of provinces of meaning and not of sub-universes because it is the meaning of our experience and not the ontological structure of the objects which constitute reality (Schütz, 1962, p. 230),

attributing its priority to ourselves, not the world:

For we will find that the world of everyday life, the common sense world, has a paramount position among the various provinces of reality, since, only within it does communication with our fellow men become possible. But the common sense world is from the outset a socio-cultural world, and the many questions connected with the intersubjectivity of the symbolic relations originate within it, and find their solution within it (Schütz, 1962, p. 294)

Similarly, here I work from the premise that it is the individual's experience of the world, of mathematics and of social interaction which govern his actions rather than externally defined notion of mathematics itself.

I wish to offer some notes from my classroom based research to assist me in demonstrating the character of this notion of personal space as it might be for a student in a mathematics classroom. In the lesson described below some students are working together on a mathematical activity. I will discuss an extract from a transcript as a

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