Artefact-Mediated Kinaesthetic Actions, Semiotic Activity, and Mathematical Thinking

Luis Radford
Université Laurentienne, Ontario, Canada

Although 20th century psychology acknowledged the role of language and kinaesthetic activity in knowledge formation, and even though elementary mathematical concepts were seen as being bound to them (as in Piaget’s influential epistemology), bodily movement, the use of artefacts, and linguistic activity, in contrast, were not seen as direct sources of abstract and complex mathematical conceptualizations.

Nevertheless, recent research has revealed the decisive and prominent role of bodily actions, gestures, language and the use of technological artefacts in the students’ elaboration of elementary as well as abstract knowledge. In this context, there are a number of important research questions that have to be addressed. One of them relates to our understanding of the relationships between, on the one hand, body movement and actions carried out through artefacts (objects, technological tools, etc.) and, on the other hand, linguistic and symbolic activity.

Research on the relationship between these two chief sources of knowledge formation (i.e. artefact-mediated kinaesthetic actions and semiotic activity) is of vital importance for a better understanding of human cognition in general and of mathematical thinking in particular. With regard to mathematical thinking the fundamental problem is to understand the way in which processes of symbolizing and meaning production relate to kinaesthetic activity and the artefacts employed therein. As our previous research suggests, highly complex algebraic symbolism cannot incorporate the students’ kinaesthetic experience in a direct manner (Radford, 2002, 2003). The severe limitations of a direct translation of actions into symbols require the students to undergo a dynamic process of imagining, interpreting and reinterpreting. The students have to pass through a dialectical process between (concrete or imagined) actions, signs and meanings. However, little is still known about this process. Further research needs to be conducted at the theoretical and experimental level.

The general aim of the research program that I am conducting is to investigate the dialectics between the students’ kinaesthetic and artefact-mediated activity and their processes of symbolizing and meaning production. The specific objectives are:

1. To investigate the role of bodily and artefact-mediated (concrete or imagined) action, perception, and linguistic activity in mathematical symbolism and in the formation of meaning.

2. To investigate the transformations that meaning undergoes when kinaesthetic and artefact-mediated activity shifts towards sign-based activity, thereby leading to what may be called ‘abstract meaning’.

1 Research program funded by Conseil de Recherche en sciences humaines du Canada CRSH / Social Sciences and Humanities Research Council of Canada SSHRC.
(3) Reciprocally, to investigate the impact that abstract meaning and mathematical symbolism have on the kinaesthetic and artefact-mediated (concrete or imagined) action, perception, and linguistic activity.

I propose a theoretical framework in which meaning is seen as a double-side construct (Radford, in press). On the one hand, meaning is seen as a subjective construct; more specifically, as related to the subjective conceptual content as intended by the individual’s intentions. On the other hand meaning is seen as a cultural construct in that, prior to the subjective experience, the intended object of the individual’s intention (l’object visé) has been endowed with cultural values and theoretical content that are reflected and refracted in the semiotic and kinaesthetic means to attend to it. Some results of this ongoing research program are presented in the articles mentioned in the References (for pdf versions of the articles please visit my webpage: http://laurentian.ca/educ/lradford/index.html.)

References
International Group for the Psychology of Mathematics Education, University of Melbourne, Australia, Vol. 4, pp. 113-120.