Abstract:

Although diagrams are considered part and parcel of mathematics, mainstream mathematicians exhibit prejudice against the use of diagrams in public. Adopting a multimodality social semiotics approach, I consider diagrams as a semiotic mode of representation and communication which enable us to construct mathematical meaning. Mathematics is a multimodal discourse, where different modes of representation and communication are used, such as (spoken and written) language, algebraic notations, visual forms and gestures. These different modes have different meaning potentials. I suggest an analytic framework that can be used as a tool to analyse the kinds of meanings afforded by diagrams in mathematical discourse, focusing on geometry.

Starting from characteristics of diagrams identified in the literature, I construct the framework using an iterative methodology tested with data from classrooms in the UK and the Occupied Palestinian territories and from textbooks. The classroom data consist of approximately 350 written mathematical texts in English and Arabic produced by 13- and 14-year-old students as a response to two geometrical problems, accompanied by audio and video records of their verbal and gestural interactions with each other while solving the problems.

I then present the critical aspects of the development journey of the framework followed by a discussion of each of the three (meta)functions: ideational, interpersonal and textual. Each of these functions is illustrated by examples of diagrams from mathematical texts collected from the empirical data, textbooks and the Internet. Because I consider mathematics to be a social and cultural practice, I discuss the issue of culture and language in relation to the meanings of diagrams.

Lastly, I discuss the implications of the study on representation and communication in mathematical discourse, with possible applications for the framework in learning and teaching mathematics.