

Positioning theory framework for analysing teaching of mathematical modelling, focusing on students' opportunities

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Positioning theory

Positioning Theory can serve as a framework for exploring and explaining how meanings are produced in and through specific context-embedded discursive practices, with an interest in how communications “position” people and the implications for the production of meaning. There are three key concepts within Positioning theory: *Positioning*, *storyline* and *social acts (speech)*, which provide a useful framework for examining the actions, interactions, and participation in a discourse (Green et al., 2020). The theory is developed from discourse theory, where the reality is seen as produced within the discourse. Through this theory the understanding of mathematical modelling is seen as produced in classroom discourse (*speech*), and the *storyline* of mathematical modelling in an episode is seen as a part of the reality of teaching and learning of mathematical modelling. The *positionings* in the episodes reveal the students' opportunities for making own decisions in the mathematisation of the mathematical modelling process, and affects how the storylines develop. Langenhove and Harré (1999) express four types of *positioning*, which I here will present from the student's point of view: (1.1) *deliberate self-positioning* can be identified when a student presents choices or their own point of view; (1.2) *forced self-positioning* happens when they are not expressing any choice of action, e.g., they “have to” solve it like this. Students may exercise (2.1) *deliberate positioning of others* (the teacher) if they ask the teacher to do something, and even (2.2) *forced positioning of others* if they elicit it, e.g., “you must”. These positionings could also be expressed from the teacher's perspective, e.g., the teacher may exercise (2.1) *deliberate positioning of others* (a student) if he or she asks a student to do something.

Mathematical modelling and positioning theory

Positioning Theory as an analytic lens draws attention to the positioning actions of teachers and students as they co-construct practices and processes in classrooms (Green et al., 2020). Within teaching and learning of mathematical modelling, students' own choices in the processes of mathematisation are emphasised. For analysing classroom situations when teaching and learning mathematical modelling, I will now present how Positioning Theory can function as a lens to explore the students' abilities for making their own choices, and how these positionings affect how mathematical modelling is communicated in the given situations. I have developed text markers for each of the *positionings* 1.1-2.2 from the students and the teacher's perspective, see Berget (2022). Here, I will give examples of how the storylines of mathematical modelling can be explored from the identified positionings, and give examples from the dialogues analysed in Berget (2022). By identifying positionings in the classroom episodes in the teaching and learning of mathematical modelling, the students self-positioning show the students initiative to include their own experiences and suggestions. The teacher's response to a student which takes initiative shows how the teacher

positions the students, if they are given opportunities in the process of mathematical modelling, or if the teacher deliberates or forces positioning of the student to rather solve the task in a certain way. Even if the formulation of a modelling tasks might be open, the students' and teachers positionings shape how mathematical modelling is understood in the discourse.

If forced self-positioning of a student is identified in the solution process of a mathematical modelling task, for example like this: "We are supposed to do it like this. You must...", it might indicate students' roles as solving the given task in a certain way. If the students have this understanding of a modelling situation, that there is a given right way of solving it, this might be a hinder for the students to develop their modelling competence. Deliberate self-positioning of a student, or deliberate positioning of the teacher, might indicate that the student question the process and suggest other approaches. For example, when a student questioned the information given in the task based on here everyday experience. She asked the teacher if she could search at the Internet for information. The *storyline* about mathematical modelling might be that the student can use their everyday knowledge to obtain more information to make arguments in mathematics. If the teacher gives them opportunities to pose additional questions, they experience to lead their solving process themselves. Positioning Theory can as an explanatory theory serve as a set of guiding principles for investigating the consequences of the discourse and interactions of, and with, particular students and groups of students as they assume, or reject, particular positions or acts of positioning. The positionings shapes the storylines of mathematical modelling produced. This new insight might reveal characteristics of classroom discourse in the teaching and learning of mathematical modelling, and following Critical Discourse Analysis, to articulate discourse elements in new ways leads to change. The first step is to identify the power relations. The use of Positioning Theory might be used in intervention project or educational design research where the aim is to develop teaching of mathematical modelling with focus on the student and the teacher role, and students' agency when working with mathematical modelling. Teaching mathematical modelling includes encouraging multiple solutions, and instructions become more open and might be challenging (Blum, 2015).

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