Students, mathematics textbooks, and agency

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This presentation reports on a study of 18 Swedish Year 1 students' (7–8 years) work with mathematics textbooks analysed according to the concept of agency. The empirical data consisted of video material, students' representations, and mathematics textbooks. The result showed that some exercises enable agency, and some do not. Also, students' opportunities for agency are affected by the notion that, according to the students, mathematical symbols is the resource that should be used to be considered successful in mathematics. A conclusion from this is that the textbook needs to be used consciously, offering different learning situations based on both opportunities for agency and multimodal aspects to provide all students learning situations that benefit both learning and the opportunity to discover themselves as mathematical individuals.

Perceiving students' work with mathematics textbooks is a central aspect of understanding mathematics learning in school, as mathematics textbooks are common teaching materials used by most students (Mullis, Martin, Foy, & Arora, 2012). The aim of the study was to discuss how students' meaning making when working with mathematics textbooks can be understood from the concept of agency. The analysis has been guided by the following research questions: Which meaning potentials are designed into the exercises?; How do the students make meaning when working with the textbooks?; and What opportunities for students' agency is possible when working with the mathematics textbook?

This study is built on multimodal social semiotics (Kress, 2010), where communication in different resources or *modes* (Kress, 2010) such as images, mathematical symbols and writing is studied. From this perspective, the student's work with the mathematics textbook is understood as the student's *meaning making* (e.g., Kress, 2010) working with the mathematics textbook. First, this study sheds light on what the textbooks are designed to offer students and, second, the students' meaning making when working with the mathematics textbook. To deepen the understanding of students' meaning making the concept of *agency* was used. Agency refers to an individual's possibility to take active participation (Bezemer & Kress, 2016). This study uses the concept based on the student's opportunity to participate when working with mathematics textbooks.

Video transcripts from 18 Year 1 (aged 7–8) students working with their mathematics textbooks were collected chosen out of a convenience sample. The video material consists of 450 minutes of film, approximately 25 minutes per child, ranging from 19 to 44 minutes. A tablet was used for documentation. Exercises were chosen

based on the results of a quantitative study (Norberg, 2021), addressing subtraction as an arithmetic operation. An analysis in three steps was conducted to understand the students' meaning making: (1) A textbook analysis of the exercises was made to capture the designed meanings (the purpose of the exercise); (2) The video material and the students' representations (their answers) were analysed; and (3) The designed meanings and the students' meaning making of the exercises were analysed according to the concept of agency.

The results showed that there are exercises where the design provides opportunities for agency as well as the opposite. Exercises that enable agency are designed so that the student can choose working methods, and this can be done by selecting the order in which the modes are used or deciding which modes to use. Exercises whose design limits students' ability to take agency are designed so that a specific way of working with the book is required to solve the exercise. It may be necessary that the work takes place in a particular order or is based on a specific mode and that the work is then done with a specific mode or certain modes. The results also showed that some students expressed that mathematical symbols are "better" to use than the other modes. Choosing the mathematical symbols mode to a greater extent over other modes was described by the students as something that shows that they are successful in mathematics, demonstrated in both words and actions. Based on the concept of agency, it is made clear that the student's opportunity for agency is affected by the notion that students who are successful in mathematics do not use the images but start from the mathematical symbols. This is expressed by several students, both students who use the image and those who do not use the image to solve the exercises.

A conclusion is that the work with mathematics textbooks for students in the early school years should be done with great awareness. A suggested design based on this is mathematics teaching that requires representations in different modes and two different learning situations. (1) One type of learning situation offering opportunities for agency where the working method is not based on individual work, and (2) another type of learning situation where the student can work individually based on clearly designed offers to consolidate content already known to the student. These two different kinds of learning situations could benefit mathematics teaching where all students learn and discover themselves as mathematical individuals.

References

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