

# LEARNING TRAJECTORIES BASED ON PROTOCOLS

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A learning trajectory according to Simon ( 1995 ) is a theoretical design for a possible way of concept development of an intended learner. Using the notion of protocol as espoused in Dorfler ( 2000 ) such trajectories are designed for the concepts of permutation and discrete function or mapping. This is done by telling a narrative about a hypothetical student in an appropriate learning environment. A protocol of an action (actual or imagined ) carried out by the learner is conceived of as a cognitive process which takes note of relevant steps, stages, conditions or outcomes of that very action. This is achieved by the learner through developing or applying graphic, diagrammatic or symbolic inscriptions which denote the aspects of interest of the action. Depending on the experience and available knowledge of the learner many different ways of producing a protocol and its inscriptions are possible. The guidance of a teacher will be helpful for arising interest in and focusing attention on the intended aspects and relationships created by the actions. In the current case as actions are chosen the placing of books on different places and the rearranging of books on numbered places. This context can be enriched by asking how many ways there are in both cases for carrying out those actions. The learning trajectory now proceeds along the development of protocols and their inscriptions in a process of stepwise refinement and change of the means of the inscriptions. They are conceived to develop from verbal reports to lists of places and books, to tables and to arrow diagrams in both action contexts. The arrow diagrams can be seen by the learner as expressing an association of elements of one sort with elements of another or in the second case as describing a kind of movement on a set of elements. The focus of attention gradually shifts to the inscriptions themselves and their properties. Thereby the diagrams and symbolic expressions and the operations on them become the objects of investigation instead of the original objects and the actions upon them. The operations by the learner on these inscriptions constitute the core of the notion of a mapping between two sets or within one set. By this process the notion of a mapping gets related to the learner's own activity thus avoiding the more common alienation of mathematics.

## References

- Dorfler, W. (2000). Means for Meaning. In: Symbolizing and Communicating in Mathematics Classrooms (eds. P. Cobb., E. Yackel and K. McClain ). Lawrence Erlbaum, Mahwah, NJ
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