

## Froebel Meets OpenSCAD: Pre-Service Teachers Form Units in Notes for Children and in Instructions for 3D Cube Constructions

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Recent studies in Australia and Germany have shown that block-play activities and especially play with the so-called “Froebel’s Gifts” offer profound opportunities to develop spatial sense in preschool and in primary school (Livy et al., 2018; Reinhold et al., 2017). These Froebel’s Gifts, specific education toys introduced by the German pedagogue Friedrich Froebel in the late 18th century, were also used as a tool to investigate Australian children’s geometrical concept knowledge (Downton et al., 2019). Based on these and related research experiences, the study we introduce in our presentation questions how pre-service teachers identify and address part-whole relationships within symmetrical arrangements made of cubes from Froebel’s Gift 3 (called “forms of beauty” by Froebel), when they are asked to give instructions for primary students. We were also interested to find out if these notes differ from pre-service teachers’ handling of instructions in tasks using a digital tool for the design of the same “forms of beauty”. Therefore, data collection included the use of *Open Spatial Computer Aided Design* (OpenSCAD, <https://www.openscad.org/>), an open program for 3 D constructions.

First analyses show that pre-service teachers’ handwritten notes not only differ in terms of the length of the descriptions, but also vary since some pre-service teachers stay very close to the (mental) construction process, guiding a fictive grade 2 recipient of the description “step by step” through the anticipated process of reconstruction. Others invite the fictive recipient to think backwards, or at least to use an underlying structure for reconstructing details, later on. In a wide range of structuring strategies, which we identified in the handwritten free texts, some of the instructions reveal a clearly holistic view on the form of beauty—starting with a general statement concerning the gestalt, which is then described step by step with a focus on different subsets of the whole, always referring back to the entire array. We suggest to call this a *global approach with analysis of units*, and contrast it to a *local approach*, where the cube arrangement appears to “break apart”, isolating merely single cubes during the description of a reconstruction process in a “piece by piece” manner. In comparison, the digital tool OpenSCAD challenges and somehow seems to urge the pre-service teachers to always keep in mind the final product. We suggest to discuss these differences and potential obstacles for children which should be addressed when introducing these tasks in pre- and in-service teacher education.

### References

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