SCIENCE & MATHS

Use of mathematics in inquiry and design lessons in primary education

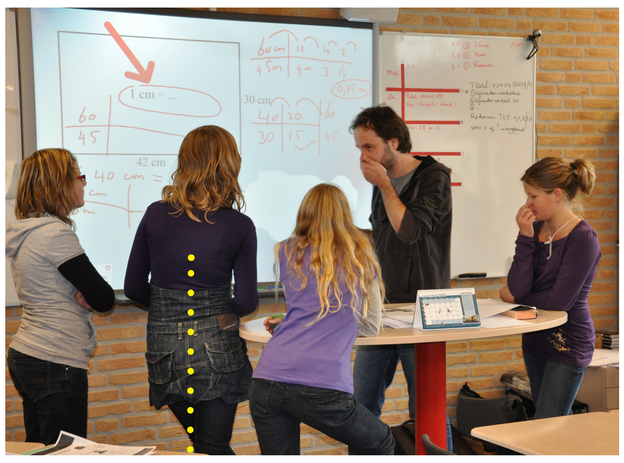
The learning and teaching strategy Learning by INquiry and Design (LIND) aims not only at developing scientific concepts, but also at so-called scientific attitudes and a great diversity of skills (Barron et al., 1998; Van Graft, Klein Tank, & Beker, 2016).

Pupils (grade 3-6) first investigate how wild animals survive in their surroundings. Each group of pupils choses an animal species. Based on the information they find about the life of this species they formulate design principles in order to design and build a zoo shelter for that particular species.

Using these design principles pupils make a sketch of the zoo shelter with accommodations and natural elements in order to approach the species' habitat. This sketch is turned into a drawing on scale which is the basis for building a 3D scale model of the zoo shelter. They calculate the amount of required materials. During the building process materials have to be cut into pieces of the right measurements and 3D constructions are made. Especially in these design steps, pupils have to apply different maths skills. Pupils already have developed these skills in the maths lessons to a certain level. However, LIND offers pupils an opportunity to apply these different maths skills and knowledge in authentic science contexts.

MATHEMATICS IN LIND LESSONS

In relation to problems to be solved, LIND draws upon the understanding of physical quantities like length, width, surface, and volume. Pupils have to determine what calculations are needed and to accurately read measuring devices.
In this series of lessons pupils also make sketches and scale drawings and build a scale model of the zoo shelter.



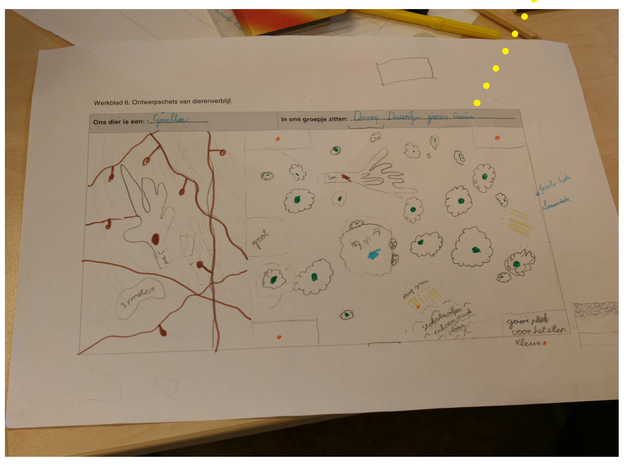
OBSERVATIONS

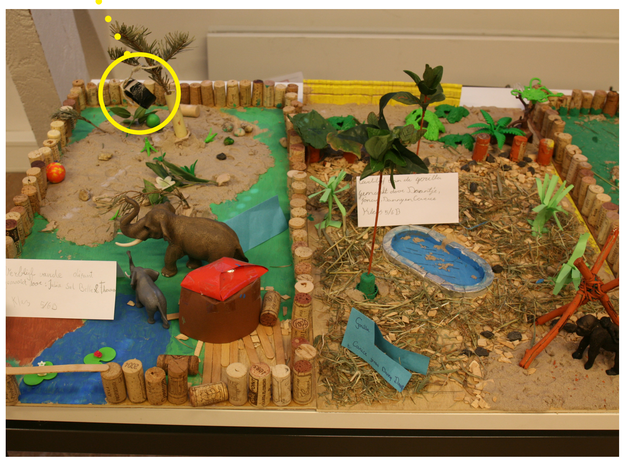
Pupils of two groups (grade 3/4 and grade 5/6) were observed. In the design steps, difficulties were observed when activities relied upon pupils' maths skills. In grade 5/6 we observed problems in pupils' understanding of measurements units like meter and square meter. When the teacher asks pupils that make a zoo shelter for turtles, they don't have any idea about the length of the shelter in relation to the needs of the animals. When pupils had to make ratio calculations to fit their scaled design on a sub-surface they felt uncertain about which ratio's they had to calculate and how to carry out those calculations. So, the teacher has to explain again how to perform those ratio calculations.

Grade 3/4 pupils showed skills that presumably were not dealt with in preceding math lessons. When pupils were asked to make sketches for the zoo shelter, they had to transform three dimensional ideas they have in mind to a sketch on a flat surface in relation to other structures.
This sketch not only contained the main structures like the buildings and pools, but also construction details. For example, a rectangle representing a car tyre their animal (an elephant) could play with, and the elephant itself including a top view with its tail, ears and trunk.

CONCLUDING REMARKS

Using the LIND strategy pupils are confronted with realistic situations that require mathematical skills. However, we observed that pupils experienced difficulties in solving certain mathematical problems. We observed a lack of understanding with respect to measurements units as well as a difficulty in picking the right attributes of the spatial objects to perform calculations at. In conclusion, LIND strategy can be considered as a rich environment in which mathematics education is integrated with science which allows pupils to further develop their mathematical skills in a meaningful and functional way. Our preliminary observation is that a lack of conceptual understanding of maths hinders pupils to apply it procedurally (Van Streun, 2001) in a science context. Further research is needed to verify and validate these observations in order to consider possible consequences for the teaching of mathematics or for the mathematics curriculum.





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slo Netherlands Institute for Curriculum Development

Marja van Graft, Martin Klein Tank
Jos Tolboom, Marc van Zanten