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Geometry in Everyday Life

G. Graumann
University of Bielefeld, FRG

SUMMARY

My conception of 'practice-orientated-mathematical education', which must be seen as one point of view side-by-side with others, has the aim to qualify pupils to master life and is based on a method of working on problems which are true to life. Therefore I plead for geometry teaching, where the formation of sound geometric concepts and the relevance of applications of geometry in everyday life is important. After discussing this conception a schedule of activities of everyday life where geometry could help, and the description of four units of geometry in everyday life, are given.

1. THE CONCEPT IN GENERAL

In my conception of 'practice-orientated-mathematical education' the point of view is the everyday world. In addition a general goal of education should be the promotion of personal development and the formation of men/women to master life and in particular to have the skills to work on problems which are true to life. In respect to the term 'everyday world' you must not see only the outward events; 'everyday world' also means the causal and social interlockings with nature and with communities such as the family, the community of a house, municipality, nation or mankind, and further means the mental and cultural goods of our own and other civilisations. In respect to later life of course we must concede that we can only make forecasts; but every pedagogical conception is concerned with this dilemma. More than that a pedagogy is alive and fruitful only when it can combine funded analysis about the future with hope and confidence in the rightness of pedagogical handlings. Furthermore, I must concede that different children have and will have different everyday worlds.

A pedagogical conception therefore must be reducible to a common standpoint as well as give enough freedom for individual formulation. We must always understand the 'orientation to everyday life' with this global view.

Owing to the comprehension of the world as a complex related unity and because of the latest scientific findings of the psychology of learning I must add a **didactic principle**. The acquisition of isolated bits of knowledge, skills and abilities are not enough, rather they must be based on concrete experiences and combined with situations which are true to life. In addition the limitation of mathematical auxiliaries, as well as the interlocking of the various aspects of realistic problems, must constantly be kept in mind.

To serve my conception and this principle as well as possible I propose to use the following method.

The subjects are more or less complex problems which are presented in the form of realistic situations, where mathematical and non-mathematical aspects will not be separated. While solving the problem, where the accent doesn't rely on mathematics but on the points you normally see in such a situation, we find out new mathematical ideas and methods or learn to use known mathematical ideas and methods. Finally we discuss the property of our solution with the help of mathematics in respect to the realistic situation.

The practice-orientated conception therefore permanently has a tendency to inter-disciplinary teaching. However because I want to realise this conception in a teaching system where mathematics is taught in special lessons, as usual, it is necessary for the mathematics teacher on one hand to select problem situations which consist of essential aspects which can be solved by mathematics and on the other hand for the class to become acquainted with considering non-mathematical aspects in mathematics lessons.

For **teaching geometry in everyday life** you have to apply the equivalent comment in respect to geometry. As you may already have seen, this conception doesn't fit with a systematic-orientated geometric instruction where theorems and proofs are in the foreground. I would rather plead for geometry teaching where the formation of sound geometric concepts and the ability to solve problems within geometry or with the application of geometry should be promoted. The aspect of proof is added later on when the attributes of special geometric objects are no longer evident. Thus a main factor of geometry teaching next to the clarification of geometric concepts through logic is the clarification and deepening of geometric concepts through application and demonstration of the relevance of geometric concepts in situations which are true to life. In such geometry teaching therefore the problem about 'geometry in everyday life' plays an important role.

2. SITUATIONS INVOLVING GEOMETRY

Being on the look-out for situations which are useful for geometric applications in the sense of the practice-orientated conception, I developed the following (not at all complete) schedule of problems of everyday life which could be solved by the help of geometry.

2.1 Handicraft and planning
- building of houses, e.g. extending a loft, planning a layout of a house, renovating a facade;

- styling of rooms, e.g. repapering a room, planning a furniture layout, designing lamps;
- cultivating of gardens, e.g. paving a path, planting a bed, sprinkling a lawn;
- planning of landscapes, e.g. surveying a region, setting a footpath, calculating a wooded area;
- arts and crafts, e.g. designing jewellery, analysing precious stones, picturing ornaments.

2.2 Industry

- metal working, e.g. constructing gearings, comparing cylinder capacities, optimising transport routes and charges, programming industrial robots;
- packaging, e.g. producing cardboard boxes, designing packagings, calculating offcuts, punching special forms, comparing sizes of pachagings.

2.3 Trade and traffic

- deliveries, e.g. loading a furniture van, stacking bags, loading containers;
- advertising, e.g. administering advertising, calculating the costs of sheets of paper for different sizes, making advertising designs (e.g. for TV);
- traffic, e.g. working out city and road maps, comparing flight routes, navigating coastal shipping.

2.4 Public affairs

- local, e.g. planning a sports field, drawing a development plan, laying a supply network;
- national, e.g. road crossings, constructing tunnels and bridges, renewing dykes, surveying and calculating storage lakes, planning solar energy stations.

2.5 Culture

- art and architecture, e.g. planning the scenery on a revolving stage, analysing church buildings, drawing famous facades;
- popular-science, e.g. determining calendars and planetary orbits, analysing shadows and sundials, computing and comparing areas of leaves, calculating curved reflectors.

2.6 Private affairs

- hobby, e.g. building models, making inlaid work, constructing kites, designing knitting patterns;
- holiday, e.g. stowing luggage into the car, testing a range finder of a bike, computing the slope of a footpath or a road;
- games, e.g. calculating in a billiards match, solving a geometric puzzle, programming a computer game.

This schedule of course can give you only a first hint for themes you can prepare for school. In the sense of my practice-orientated conception you have to pick out a special problem and look out for a solution and its geometric tools.

3. UNITS REALISED IN SCHOOL

To get an impression of such preparation I will describe four *used in schools*.

3.1 Extending a loft

This unit was taught by students to 14-year-old children in a basic course of a 9-year elementary school. It was worked out in a seminar of mine concerning practical experiences within teacher education.

The first lesson was role-playing, in which the situation of two boys in a family with a small house was used to introduce the situation of life. In the following the problem of building out a loft was discussed. Among other things it was recorded that because of financial problems the family would do the work themselves and that making a plan which included the calculation of costs was also necessary. It was noted that the most important work is the insulation. In addition different forms of a roof were discussed and after that the teacher chose the form or a hip-roof. Also a picture of 'that' house was shown.

In the second lesson the situation was summarised. Then the partial problem of calculating the covering of the floor and the walls was worked out. The solution was worked out in groups. As a positive by-product different methods of solution came out and were compared.

In the third lesson the installation of heating elements was dealt with. Since the size and the price of the heating depends on the volume of the loft, the computation of the volume was the main task in this lesson. The lesson was taken by five teacher students simultaneously where each student taught to a small group of children. For each group a model of the hip-roofed solid made of synthetic moss was available. The children themselves had the idea to cut the model into pieces which was easily done with a knife. Then they could compute the middle part, a prism. With the peaked solids several reflections and trials were done by the children, until some of them cut those solids into two halves and put three of these halves together to a cube.

In the fourth lesson the calculation for the heating was finished and then the solution of the entire problem was worked out.

A test about this subject was given some days later.

3.2 Shape and weight of packings

The unit was taught in two parallel classes in the eighth grade of a 9-year elementary school.

In the first lesson different consumer goods were presented to the children. They firstly had to classify the objects in respect of material, shape, size and weight, as well as price. Afterwards the different shapes were discussed more fully.

In the second lesson the volume of rectangular and cylindrically formed detergent boxes were computed. The question was whether the volumes of boxes with equal weight are equal too.

In the third lesson the problem was to calculate the cardboard mass. For this the children had to compute the surface of the detergent boxes in particular.

In the fourth lesson the subject was called 'deceptive backings'. First the outside and the inside volume of the detergent were compared. After that a cylindrical shaped cream box was treated in the same way.

In the fifth lesson the volume of an oil can with the form of a conical frustum was computed.

In the sixth lesson some boxes whose shape can be seen as a composition of two or three basic solids were calculated. Such boxes are, for example, fish-tins, oil-cans and several boxes for sweets. In the test some other objects of composed shapes such as a greenhouse, television aerial mast, space capsule, treasure chest and goods van had to be computed.

3.3 Dyke raising

This unit was first worked out and tested by a student teacher in connection with an exam, and later on was also used by students in their practical course. On both occasions it was taught to 14 to 16-year-old children.

In the first lesson the introduction into the problem was done on the subject of a stormy tidal wave. The lesson began with pictures and discussion about tidal waves and thier destructive effects as well as their prevention. At the end of the lesson the children put themselves into the situation of a planner or member of parliament of a special state where the dyke has to be renewed and raised up.

In the second lesson, which immediately followed the first, a discussion about points of cost took place. Afterwards each child had to compute the volume of the old dyke, the data for that having been given by the teacher.

In the third lesson the volume and costs of the sand kernel for the new raised dyke was worked out in groups.

In the fourth lesson, also in groups, the children calculated the costs for the clay layer of the new dyke, including the costs for the transport of sand and clay. For one lorry a single journey for a flat rate was given to the children.

In the fifth lesson the children went on to calculate area and costs of the grass layer, and to estimate the costs for the workers and the machines. For that the children got standard prices which the student teachers had asked for previously. Finally, at the end of this lesson, the total costs for a realistic dyke were determined.

In the sixth lesson several skills were practised once more.

In the seventh lesson a test was given about the total problem.

3.4 Geometry and arts

A unit about geometry and arts was once taught by myself in a project week of a 9-year elementary school, and another time was worked out and taken by students in two parallel classes of sixth grade in a 10-year elementary school.

In the first lesson of this unit the different shapes of buildings of different ages were discussed, using slides.

In the second lesson, which immediately followed the first, the children were asked to copy by hand some fronts of such buildings seen in the first lesson. The fronts were given out as a picture for each child. The many round arches of the Porta Nigra in Trier took a lot of time and effort. As homework, the children had to visit buildings in the town and make a description of at least two buildings.

In the third and fourth lessons, being a double lesson too, the concepts of a rectangle and a circle were repeated and the handling of a pair of compasses was introduced. They then had to practice handling a pair of compasses and a ruler by making figures which were composed of rectangles and circles or parts of them.

In the fifth and sixth lessons these skills were applied to design ornaments.

Finally, in the seventh and eighth lessons the children produced pictures made of coloured yarn and cardboard, in which figures of rectangles and circles were used as a basis. The children could work creatively at it.