# What is discrete mathematics and how should we teach it?

# WHAT IS DISCRETE MATHEMATICS AND HOW SHOULD WE TEACH IT?

*Jacobus H. van Lint*

*Eindhoven University of Technology [NLD]*

Quite often courses with the name "Discrete Mathematics" do not deserve that name. The subject is *not* the union of all subjects in mathematics that are not part of a calculus course but are necessary knowledge for students of computer science. It also happens quite often that a course in what I do consider to be discrete mathematics leaves the students with the impression that there is no structure in the subject. Each problem requires what appears to be an ingenious trick and a new problem also a new trick. This lack of structure is sometimes caused by choosing a too limited subset of topics from discrete mathematics as course material.

Discrete mathematics is concerned with discrete structures that are usually finite, but not always. It includes elementary number theory, combinatorial theory, finite groups, finite fields, finite geometries, and also newer areas such as coding theory. A course in discrete mathematics should be structured as a multigraph with, as independent sets, subsets of the following:

1. Objects: graphs, lattices, geometries, designs, codes, coverings, partitions, systems of sets, matroids;
2. Representations: addressing schemes, coding, (0,1)-matrices, (0,1)-sequences, graphs, diagrams, pictures, subsets of lattices;
3. Ideas: counting techniques, probabilistic techniques, (non)-existence methods, construction techniques, unification (e.g. matroids), optimization methods, max-flow, search techniques, symmetry;
4. Tools: algebra (matrix theory, groups, group rings, finite fields), elementary number theory, permutation groups, geometry, analysis (power series, Lagrange inversion).

Students should not only learn many applications but also to recognize situations in which a certain object from discrete mathematics is the *natural* tool to use. Most important is to get students to *enjoy* the subject by using applications that are surprising or ingenious, challenging problems, and recent applications such as satellite communications and the compact disc.

Let the students work on (homework) problems, preferably in groups of two or three, a few weeks *before* the relevant methods and theorems are treated. They often come up with (sometimes long and clumsy) solutions. The result is that in class they quite often immediately recognize that you are providing them with a *tool* that they desperately needed some weeks earlier.

## Reference

Van Lint, J.H., & Wilson, R.M. (1992). *A course in combinatorics.* Cambridge, UK: Cambridge University Press.

# THE PROFESSIONAL DEVELOPMENT OF TEACHERS THROUGH RECOGNIZING, DOCUMENTING AND SHARING THE WISDOM OF PRACTICE

*Charles Lovitt*

*Curriculum Corporation of Australia, Melbourne [AUS]*

The reform or growth agenda in mathematics is very similar across many countries. In Australia it is expressed in *A National Statement on Mathematics for Australian Schools.* The major thrust of this presentation is that there is within the teaching community a vast untapped resource of understandings and expertise about teaching and learning. Capturing and sharing this wisdom, is arguably the most productive pathway to successful implementation of the reform agenda.

The presentation briefly illustrated four captured classroom images, three presented on slides and one as a workshop activity. The four were titled;

1. Algebra walk;
2. Night and day, and time zones;
3. Problem solving task centers;
4. Crazy animals.