3.5 Curriculum and goals

ISSUE 4. *To what extent does applications and modelling have the potential to provide an environment to support both students and teachers in their development of appropriate beliefs about and attitudes towards mathematics ?*

Examples of specific questions:

- What are the implications of research on the role of beliefs, attitudes and emotions for changing teaching practice and classroom cultures with respect to applications and modelling ?
- What strategies are feasible for in-service teacher education that will address the fear experienced by some teachers when faced with applications and modelling ?

3.5 CURRICULUM AND GOALS

It is argued that applications and modelling can make fundamental contributions to the development of students' mathematical competencies.

ISSUE 5a. *What would be an appropriate balance – in terms of attention, time and effort – between applications and modelling activities and other mathematical activities in mathematics classrooms at different educational levels ?*

Examples of specific questions:

- Is it possible – or desirable – to identify a core curriculum in applications and modelling within the general mathematical curriculum ?
- Which applications, models and modelling processes should be included in the curriculum ? Do answers depend on each teacher or should there be some minimal indications in national and state curricula ?
- Is it beneficial to generate specific courses or programs on applications and modelling or is it better to integrate applications and modelling into standard mathematical courses ?

The university level represents a particularly problematic case. Although there are differences between places and countries, university graduates in mathematics embark on a large variety of professional careers, many of which will have links involving applications and modelling – including research mathematicians through their research or teaching responsibilities.

ISSUE 5b. *Should all university graduates in mathematics acquire some applications and modelling experiences as part of their studies ? If so, what kinds of experiences should they be ?*

Concerning general education at the school level, some special questions arise. Mathematics accounts for a large proportion of time in school – this is only justified if mathematics can contribute to general education for life after school.

ISSUE 5c. *How and to what extent can applications and modelling contribute to building up fundamental competencies and to enriching a student's general education ?*

Examples of specific questions:

- What meanings can be given to 'general education', and what is the role of mathematical modelling therein ?

- What is a suitable balance within general education between creating one's own models of real situations and problems, and making judgements about models made by others ?

3.6 Modelling pedagogy

The pedagogy of applications and modelling intersects the pedagogy of pure mathematics in a multitude of ways and requires at the same time a variety of practices that are not part of the traditional mathematics classroom. Approaches to teaching applications and modelling vary from the use of traditional methods and course structures, to those that include a variety of innovative teaching practices.

Issue 6. *What are appropriate pedagogical principles and strategies for the development of applications and modelling courses and their teaching ? Are there different principles and strategies for different educational levels ?*

Examples of specific questions :

- What research evidence is available to inform and support the pedagogical design and implementation of teaching strategies for courses with an applications and modelling focus ?
- What criteria are most helpful in selecting methods and approaches suggested by theories of human development and/or learning ?
- What obstacles appear to inhibit changes in classroom culture e.g. the introduction of interactive group work in applications and modelling ?
- What criteria can be used to choose the most desirable option at a particular point within an applications and modelling teaching segment (e.g. whether to use individual and group activity) ?

3.7 Sustained implementation

To sustain change in an educational system is a major challenge as it involves and impacts upon many different parties, including politicians, curriculum developers, teachers, teacher educators, and mathematics faculty members at the post secondary level.

Issue 7. *In spite of a variety of existing materials, textbooks, etc., and of many arguments for the inclusion of modelling in mathematics education, why is it that the actual role of applications and mathematical modelling in everyday teaching practice is still rather marginal, for all levels of education ? How can this situation be reversed to ensure that applications and mathematical modelling is integrated and preserved at all levels of mathematics education ?*

Examples of specific questions :

- What are the major impediments and obstacles that have existed to prevent the introduction of applications and mathematical modelling, and how can these be changed ?
- What are the requirements for developing and sustaining a mathematical modelling environment in traditional courses at school or university ?
- How can it be ensured that the mathematical modelling philosophy in curriculum documents is mirrored in classroom practice ?