

**Institute for Advanced Study/Park City Mathematics Institute  
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**International Recommendations for National Standards and Norms  
Concerning Teachers' Preparation and Working Conditions**

“No educational system can be better than the quality of its teachers, nor can a country be better than the quality of its education” (Uganda Ministry of Education and Sports, 1992)

**Preface**

For an educational system to be effective, and this is especially true concerning mathematics, teachers require not only a thorough preparation but also respect and social guarantees. They need guarantees concerning their physical safety; they need salaries that allow for average or adequate living standards for themselves and their families without requiring excessive work hours.

Teachers have a right to continuous assistance from institutions and organizations that support professional development. This professional development should ensure that teachers' knowledge base and teaching methods reflect current knowledge and the “best practices” identified by sound scientific research.

In view of the importance mathematics teachers have or should have in societies in every country in the world, we offer several recommendations for ensuring that their preparation and working conditions facilitate, or at the very least do not inhibit, their ability to carry out the tasks of preparing today's students for tomorrow's challenges. These recommendations are the product of a consensus between an international group of mathematicians, mathematics educators, and secondary school teachers in attendance at the 2005 Park City Mathematics Institute (PCMI) International Seminar.

**Recommendations**

1. Norms for teacher preparation

a. Norms for elementary teacher preparation

Teachers should have a general foundation in a wide variety of topics, some of which may be optional and some not depending on the country/institution in which they study. These include:

- ◆ Foundations of Education (optional)
  - History of Education
  - Economics of Education
  - Administration of Education
- ◆ Psychology (optional)
  - Developmental Psychology
  - Child Psychology and Physiology
  - Counseling and Guidance
- ◆ Science, Language, and Ethics (optional)

The following mathematical topics may be considered to be the minimal basic foundation and, therefore, should be required:

- ◆ Arithmetic
  - Numeration systems and natural numbers
  - Arithmetic operations, integers
  - Fractions and percentages
- ◆ Geometry
  - Geometric figures in two and three dimensions
  - Measurement including length, area, and volume
- ◆ Algebra
  - Basic algebra
  - Algebraic equations and inequalities
  - Graphs, diagrams, information interpretation

These topics should be covered in at least four one-semester courses. Teachers should also have guided teaching practice.

Special attention must be paid to those responsible for teacher education as well. In addition to fulfilling the general requirements for faculty members in mathematics, those who educate future mathematics teachers should have a well-rounded cultural background and the desire to help students become teachers.

b. Norms for secondary and high-school teachers' mathematical preparation

Students should earn a Bachelor of Science degree that consists of a *1<sup>st</sup> cycle* of core mathematical content that includes:

- ◆ Calculus
- ◆ Elementary Number Theory
- ◆ Algebra
- ◆ Geometry
- ◆ Discrete Mathematics

Teachers' preparation should also include, as a *2<sup>nd</sup> cycle*, a flexible curriculum that includes courses such as:

- ◆ Foundations of Mathematics
- ◆ Number Theory
- ◆ Differential Equations
- ◆ Differential and Convex Geometry
- ◆ Abstract Algebra
- ◆ Topology
- ◆ Modeling, Technology
- ◆ Analysis
- ◆ Probability and Statistics
- ◆ Numerical Analysis
- ◆ Linear Algebra
- ◆ Computer Programming
- ◆ History and Philosophy of Mathematics
- ◆ Review and Analysis of Textbook

In addition, they should have two semesters of general education courses (such as psychology, foundations of education or those described above as optional) and mentored practice at one or two secondary schools.

c. Norms for both elementary and secondary teacher preparation

- ◆ All prospective teachers should have courses in pedagogy and didactics appropriate for their teaching level
- ◆ The didactics courses should focus on the connection between mathematics and the didactics of mathematics

2. Norms for teachers' working conditions

- ◆ Young teachers need guidance and encouragement in their first working years. Professional mentoring should be provided that is supportive not just evaluative/critical.
- ◆ Teachers need continuous education to remain intellectually active and up to date. We recommend that teachers receive a paid sabbatical semester every five to ten years of teaching.
- ◆ Teachers' work schedule should take into account that for each hour of contact time teaching students at least one hour is needed for lesson preparation, grading, and administrative work. Thus, the teaching load of schoolteachers should be no more than twenty-four hours per week, including time spent mentoring others.
- ◆ Salaries should be sufficient to allow teachers to make a living for themselves and for their families while holding one teaching position as their sole professional occupation. Salaries should increase according to years of experience, acquisition of additional academic degrees (such as a master's and doctorate), and demonstrated competence (such as that indicated by awards and achievements). Extra hours spent in activities related to teaching and mentoring should be paid accordingly.
- ◆ Class size is important for effective education, and a rational plan is necessary. A rational plan is one that maximizes teacher-student interaction. Actual teacher-student ratios should be based on the context and the culture, but a maximum number that does not exceed 40 students per class should be attempted. If class sizes must exceed this number then additional support such as a teacher's aide should be provided.
- ◆ Teachers should not be pressured by administrators, parents, or society in general to give high marks to their students when such marks are not related to students' actual knowledge of the subject matter. Strategies should be pursued to minimize the distorting effects of such pressures; one such strategy is the use of unified or national tests in assessing students' achievement of the expected academic standards.

**Reference**

*The Uganda Government White Paper on the Education Policy Commission Report (1992).*  
Ministry of Education and Sports.