IEA TEACHER EDUCATION STUDY:
A CROSS-NATIONAL STUDY OF PRIMARY AND SECONDARY MATHEMATICS TEACHER PREPARATION
TEDS-M 2008

What is TEDS-M?

TEDS-M 2008 is a comparative study of teacher education with a focus on the preparation of teachers of mathematics at the primary and lower secondary levels. TEDS-M will pay particular attention to the links between teacher education policies, practices and outcomes. The study will provide participating countries with a valuable opportunity to conduct research on their own teacher education system and to learn from approaches used in other countries.

Teacher education has become an area of considerable interest among policy makers in many countries over recent years. This reflects a growing body of research on the central importance of teacher knowledge and skill to quality learning opportunities for students. It also reflects the need to recruit and prepare a new generation of teachers as large numbers of current teachers reach retirement age.

TEDS-M will address research questions of central interest to policy makers who want to improve the effectiveness of their teacher education system, such as:

- What are the characteristics of teacher education programs that prepare future teachers of mathematics effectively?
- What kinds of learning experiences are effective in transforming beliefs of future teachers about teaching and learning mathematics?
- What kinds of school experience are most effective in preparing teachers effectively?
- How can the outcomes of teacher education programs for teachers of mathematics be measured in ways that are reliable and valid?
- Under what conditions can national policies for the regulation or accreditation of teacher education have a positive impact on the quality of outcomes from teacher education?
- What kinds of policies are proving to be effective in recruiting teachers of mathematics from a diverse range of social and cultural backgrounds?

TEDS-M has three components:

COMPONENT I: STUDIES OF TEACHER EDUCATION POLICY FOR ELEMENTARY AND LOWER SECONDARY MATHEMATICS TEACHERS AND ITS CULTURAL AND SOCIAL CONTEXTS

Objective:

Component I will examine the *intended, implemented* and *achieved* policy directed at mathematics teachers including recruitment, selection, preparation, and certification.

Questions:

(a) What are the policies that regulate and influence the design and delivery of mathematics teacher education for elementary and lower secondary teachers within and across countries?
(b) How do countries' distinctive political, historical, and cultural contexts shape mathematics teaching and learning and how do these influence policy and practice in mathematics teacher education?
(c) What are the consequences of policy for the development of standards for degrees, coverage of topics, and certification practices? What are the consequences of policies for the recruitment, selection, and preparation of future mathematics teachers? Are these policies coherent across the board or are they competing with each other?
(d) What would it take (in terms of resources, capacity, and costs) to bring the preparation of average mathematics teachers to the level of that which produces high quality primary and lower secondary mathematics teachers across participating countries? What are the comparative costs of implementing alternative teacher education policies in different contexts?

Data collection instruments:

These studies will use a set of guidelines and *protocols* in conjunction with *interviews* and *focus groups* of policy makers in teacher education to examine:

(a) Documents reflecting national level policy regarding the teaching of mathematics underlying each route;

(b) Descriptions of the mathematics curricula for the different teacher education programs within routes;

(c) Description of the primary and secondary school curriculum, standards and examinations;

(d) Implementation of teacher policy (recruitment, selection, and certification) within each route and institution; and

(e) Cost of alternative mathematics teacher education for elementary and secondary future teachers.

These data will reveal national teacher preparation policy and current trends; how national authorities define a qualified mathematics teacher; their implicit or explicit theories about how one becomes qualified; the kinds of policies that produce enough highly qualified mathematics teachers; and the continuity of these policies from development to implementation. Because of the complexity entailed in defining a route in countries with a decentralized or federalized governance structure we will select states or localities recognizing that policy structures vary widely by state, and that within a state the alternative pathways to credentialing vary as well.

<u>What is required from NRC</u>: The NRC will be responsible for collecting relevant policy documentation on *mathematics* teacher recruitment, selection and certification policies, and teacher policies on mathematics preparation. The NRC will also collect information about the mathematics teacher education curricula and primary and secondary school curricula, and the national level data required for the cost study. NRC is responsible for filling protocols and for bringing together focus groups to answer questions left unanswered by the document analysis.

COMPONENT II: STUDIES OF ELEMENTARY AND LOWER SECONDARY MATHEMATICS TEACHER PREPARATION ROUTES, PROGRAMS, STANDARDS AND EXPECTATIONS FOR TEACHER LEARNING

Objective:

To examine the *intended* and *implemented* curriculum of teacher education.

Questions:

(a) What kinds of institutional and field-based opportunities are provided for future primary and lower secondary mathematics teachers?
(b) How are program expectations, curriculum and standards enacted?
(c) What are the qualifications and prior experiences of the university mathematics lecturers/professors/teachers and teacher educators responsible for implementation of these programs?
(d) What factors explain how much impact routes, programs and practices have on the mathematics knowledge of future teachers of mathematics?

Data collection instruments:

a) Institutional Questionnaire of Teacher Preparation Programs The questionnaire will ask questions regarding the nature and depth of mathematics taught to future teachers in general education and in the professional curriculum; the kind of program future mathematics teachers follow (e.g., consecutive or concurrent); the standards for teacher preparation in mathematics; the kinds of assessments and the level of performance required; and the pedagogical preparation, and mathematics-specific pedagogical preparation. It will also include questions on resources used to operate teacher education programs, and a general profile of teacher educators (e.g., credentials, professional path, courses taught). In case where the country has a consecutive route, only future teachers in the last year of teacher education will be surveyed, and their knowledge of mathematics will be approximated from the study of the national curriculum.

TEDS-M WILL SAMPLE INSTITUTIONS: National probability sample of teacher education institutions in each country

In countries where institutions offer both elementary school and secondary school education, one list and one sample combining elementary and secondary schools will suffice for each route. Similarly, some institutions may offer more than one route. In such cases, the frame should be organized by the number of routes an institution offers. Some countries may opt to select a cohort of beginning students. In that case, the larger of the two cohorts should be used as a measure of size.

Target Population: A secondary or post-secondary institution offering opportunities to learn (OTL) to future elementary and secondary mathematics teachers within a major route.

Sampling Frame: Identification of routes that can lead to *elementary and secondary school teaching*; within each route, identify eligible institutions within target population, with some measure of size (e.g. number of future elementary and/or secondary school

teachers in their final year's cohort.). If the figures for primary and secondary grades are difficult to obtain, use readily available figures for the total size of these populations at elementary or lower secondary levels. Include required stratification variables.

Sample Design: Stratification by additional attributes, such as type of institution, urban/rural setting, sub-national region or administrative jurisdiction. Selection using a stratified PPS systematic sample design. National conditions may make this design choice impractical, in which case the national design must be approved by the sample referee in agreement with the TEDS-M Joint Management Committee.

Sample size: At least 50 institutions from each route. Countries with much smaller numbers of institutions will conduct a census. Countries with much larger numbers of institutions will sample institutions.

b) Questionnaire for Mathematics Instructors and Teacher Educators This questionnaire will collect data from mathematics instructors and teacher educators on their background, their mathematics teaching knowledge, the materials used in instruction, their espoused theories for teacher change, and their expectations for their future teachers. Parts of this questionnaire will be similar to the Future Teacher Questionnaire, as we propose to examine correspondence and differences between faculty and future teachers (on such things as knowledge, pedagogy, and beliefs) as an indicator of coherence and its possible effects on teacher education impact on outcomes.

TEDS-M WILL SAMPLE INSTRUCTORS: Sample of mathematics instructors and teacher educators

If sub-sampling of instructors is deemed required or appropriate, a list of the eligible instructors must be drawn and a sample plan must be submitted for acceptance.

Target Population: Persons with regular, repeated responsibility to instruct or mentor future elementary and lower secondary mathematics teachers within a given route.

Sampling Frame: Establish list of eligible instructors at each sampled TE/TL institution with a minimum of four strata as follows: (1) instructors of mathematics whose primary responsibility is to teach the content of mathematics; (2) teacher educators whose primary responsibility is to help students understand the pedagogy and learning of mathematics in elementary and/or secondary schools; (3) other teacher educators in academic component; (4) other teacher educators in field experience component. These four strata applies to instructors of both elementary and lower secondary future teachers when appropriate.

Sample Design: All eligible instructors within sampled institutions will be surveyed. National conditions may make this design choice impractical, in which case the national design must be approved by the sample referee in agreement with the TEDS-M Joint Management Committee.

Sample size: In nearly all institutions it is expected that the number of eligible instructors will be too small for sub sampling in at least one and frequently more than one of the strata. Sub sampling will be used only when the *n* within the stratum of a sampled institution is larger than needed and overly burdensome to survey.

c) Content Analysis of the Teacher Education Mathematics Curriculum A protocol will be developed to analyze syllabi and sample assignments from the teacher education mathematics curriculum in relation to mathematics standards for primary and secondary students in the participating country and to the TIMSS international database of mathematics content standards. In addition, the protocol will examine the relation between the content covered and performance expectations of courses in the mathematics teacher education curriculum and the local or national examinations for teacher certification or licensing. Such analyses will produce an initial profile of the implemented curriculum in mathematics teacher education in terms of the knowledge, pedagogy, dispositions and other knowledge future teachers are exposed to as they get ready to teach.

What is required from NRC: The NRC will be responsible for gaining entrance to the teacher preparation institutions, and finding the most appropriate person(s) to answer the institutional questionnaire. NRC will need to have a dedicated investigator per institution to administer surveys to the instructors, and to help gain access to the implemented curriculum (e.g., syllabi, texts and examinations used in the program by the selected instructors). The NRC will do the teacher education curriculum analysis according to agreed upon guidelines.

COMPONENT III: STUDIES OF THE MATHEMATICS AND RELATED TEACHING KNOWLEDGE OF FUTURE ELEMENTARY AND LOWER SECONDARY SCHOOL TEACHERS

Objective:

To examine the *intended* and *achieved* outcomes of teacher education.

Questions:

(a) What is the content knowledge of mathematics that future teachers are expected to acquire across the participating countries?
(b) What is the depth of understanding that they are intended to achieve?
(c) What beliefs about teaching and learning mathematics are promoted by teacher education programs? What beliefs do they hold about teaching and learning mathematics at the end of their preparation?
(d) What is the knowledge for mathematics teaching (e.g., of the content, pedagogy, curriculum, and attitudes) future elementary and lower secondary mathematics teachers actually have at the end of their teacher preparation and once they are considered as "ready to teach"?
(e) What other characteristics help explain their ability to master this knowledge?

Data collection instrument:

The ***future teacher questionnaire*** will measure the *intended* and *achieved* mathematics and teaching-related knowledge and believes among future teachers in each year in the sampled teacher education programs.

The questionnaire will ask future teachers about their:

- academic background
- mathematics content knowledge
- knowledge of mathematics specific pedagogy and of general pedagogy;
- beliefs concerning pupils' dispositions and abilities when learning mathematics
- beliefs about purposes for learning mathematics
- self-perception of their level of preparedness to teach mathematics effectively

TEDS-M WILL SURVEY FUTURE TEACHERS: National probability sample of future teachers

The sample should be distributed among the selected teacher education institutions as evenly as possible. Countries that opt to sample from both beginning and ending cohorts have to prepare one list per cohort and draw a full sample size from each cohort list. Countries that opt to allow for sub-national comparisons should ensure that an effective sample size is selected from each of the sub-national domains of interest, and adjust their total sample size accordingly. If the sampling of future teachers differs from these specifications a new more workable design must be approved by the sample referee in agreement with the TEDS-M Joint Management Committee.

Target Population: Future teachers are defined as all members of a route, starting from the point at which they are enrolled in formal OTL explicitly intended to prepare teachers qualified to teach mathematics in any of the grades comprising primary and secondary levels in their last year of teacher education.

Sampling Frame: List of eligible students in their last year of training from each sampled institution within identified routes. If following the national option, future teachers will be stratified by their annual cohort. In institutions that prepare teachers for both primary and lower secondary schools, there is a need to sub-sample for both domains.

Sample Design: The simplest approach will consist in equal size simple random sampling of eligible future teachers from the sampled institutions.

Sample size: An effective national sample size of 400 future primary and secondary teachers for each route is desired.

What is required from NRC: In addition to implementing the sample design, the NRC will be responsible for appointing a researcher to institutions to organize the application of the survey of future teachers in their last year in teacher education.

Research Design and Methodology for the TEDS-M study

The study surveys future teachers at the end of their teacher preparation to study elementary and lower secondary teacher mathematical knowledge and its relationship with future teachers' opportunity to learn. The study provides for a national option the study of cohorts (one at the entry and one at the exit level of teacher preparation). The overall design for the study is discussed and justified in detail in the Conceptual Framework a 60 page long document submitted to GA members in October 2004 in the GA Meeting in Taipei and available from the IEA Secretariat. In consultation with participating NRCs, this document will be revised for final publication by IEA in 2006. The data collection will be standardized according to IEA's data collection quality standards and will use – among others – On-Line Data Collection Tool.

TEDS-M WILL USE NATIONAL PROBABILITY SAMPLES AND A CUSTOMIZED SAMPLE PLAN FOR EACH PARTICIPANT COUNTRY

One of the paramount principles of IEA design is to base cross-national comparisons on national probability samples. This approach includes development of an international master sampling plan, adaptation of this master plan to national contexts, and adjudication of differences by an IEA designated sampling referee. The TEDS-M will sample teacher education institutions, instructors and future teachers.

What will be learned from TEDS-M?

- ***TEDS-M provides answers on the POLICY AND CONTEXT of mathematics teacher education:***

TEDS-M will study the intended and implemented policies that support primary and lower secondary teachers' achieved level and depth of mathematics and related teaching knowledge, and how teacher policies influence the structure of primary and lower secondary mathematics teachers' opportunities to learn.

- ***TEDS-M provides answers on the ORGANIZATION of mathematics teacher education:***

TEDS-M will study the learning opportunities available to prospective primary and lower secondary mathematics teachers which allow them to attain the knowledge they need to teach mathematics. It will also study the structure of the opportunities, the content taught in teacher education programs, and the organization of instruction.

- ***TEDS-M provides answers on the OUTCOMES of mathematics teacher education:***

TEDS-M will study the level and depth of the mathematics and related teaching knowledge attained by prospective primary and lower secondary teachers, and how this knowledge varies across countries.

What value will the TEDS-M study add to existing research on teacher education?

TEDS-M is the first mathematics teacher education study to follow a rigorous methodology to:

- Gather empirical data on the experience of the participating countries to contribute to policy debate over the nature, benefits and costs of teacher education;

- Strengthen the knowledge base to address participating countries' national priorities;

- Develop concepts, measurement strategies, indicators and instrumentation to strengthen the research in this field;

- Further a more scientific approach to the study of teacher education and teacher learning in mathematics.

THE TEDS-M FINAL REPORT WILL BRING TOGETHER THE THREE COMPONENTS

The route and institutional profiles of teacher education, the institutional questionnaire, the curricular analysis, and the instructor / teacher educator data will provide an institutional and larger contextual frame for the analysis of program data collected in this study. These data will help to refine key concepts, and to clarify the theorized coherence and further analysis across and within programs as they influence teacher knowledge (via curriculum and instruction). We will use flow diagrams indicating the sequence of program actions; and organizational schemes indicative of the resources--material, financial, personnel--that programs require to work as intended. The data collected from the Future Teacher Questionnaires will be correlated with the institutional data in order to construct profiles of the *intended, implemented,* and *achieved* curriculum for mathematics teachers by country, route, and institution.

HOW LONG IS TEDS-M?

The study will span four years: [1]

Oct 2005- Sept 2006

- Revision and publication of conceptual framework document (D);
- Initiation of national studies of policy and curriculum analysis;
- Initiation of meta-analysis on mathematic teacher education effectiveness;
- Review, adaptation of P-TEDS instruments, and piloting of additional items;
- Design of national TEDS-M probability samples of TE institutions, future teachers and the instructors of future teachers (D).
- Two NRC meetings:
  13 – 16 February 2006, Hamburg,
  03 – 08 September 2006;

Oct 2006-Sept 2007

- Submission of national reports on policy studies and curriculum analysis (D);
- Draft, review and release meta-analysis on mathematic teacher education effectiveness (D);
- Draft, review and release of final international report on national policy studies (D);
- Draft, review and release of final international report on curriculum analysis (D);
- Finalization of instruments for triple survey (institutional, mathematics instructor / teacher educator, and future teacher) with field trial of instruments and procedures; execution of sample designs (D);
- Manuals for triple surveys (D);

Oct 2007-Sept 2008

- Main data collection in Southern Hemisphere;
- Main data collection in Northern Hemisphere;
- Entering, scoring, cleaning, weighting and scaling of data;
- Analysis of data;
-

Oct-2008-Sept 2009

- Review of draft international report;
- Release of final international report (D);
- Release of international data base and users guide (D);

(D) = DELIVERABLES

HOW IS TEDS-M MANAGED?

[1] We plan to gain additional funding for a study of beginning teachers to follow the TEDS-M study proposed herein, to extend the measures of the *achieved* curriculum of teacher education to the first years of teaching.

- The TEDS-M Joint Management Committee (JMC) oversees the entire TEDS-M effort.
- This committee is responsible for overall project planning as well as for ensuring sound financial, personnel and logistical management, as well as accountability to IEA and the funding agencies.
- The JMC reports to the IEA General Assembly, Standing Committee, and Technical Executive Group on behalf of TEDS-M.

HOW DO TEDS-M 2008 and OECD Teacher Survey 2007 COMPARE?

The IEA-TEDS-Mathematics Study and the OECD Teacher Survey are two projects that complement each other and are very different. While TEDS-M's focus is on the empirical study of Teacher Education effects on future primary and secondary mathematics teachers, OECD's Teacher Survey focuses on a meta-analysis on instructional effectiveness and processes and seeks to develop indicators on school and teacher effectiveness. As the first project to ever attempt to undertake the study of the preparation of future primary and secondary mathematics teachers IEA-TEDS-M has some unique features:

FEATURES UNIQUE TO TEDS-Mathematics 2008

• TEDS-M study of Mathematics Teacher Education will survey: institutions, instructors, and future teachers.
• Collects curriculum information on mathematics teacher preparation for primary and secondary teachers allowing establishing links between the organization and content of teacher preparation and outcomes.
• National probability samples of institutions and future teachers enable matching future teachers' knowledge to the instructional practices in teacher preparation.
• Optional cohort design provides information about the level of mathematics preparation required for entering teacher education and the value added of teacher preparation at graduation.
• Reports knowledge of mathematics, mathematics pedagogy, pedagogy and beliefs of future mathematics teachers describing what teachers learn and allowing for the establishment of international benchmarks.
• Compares teacher education curriculum with primary and secondary school mathematics curriculum in terms of standards and examinations thus establishing levels of consistency between what teachers learn and what they are asked to teach.
• Studies costs of teacher to document what would be the costs of improving mathematics teacher preparation and the comparative costs of implementing alternative teacher education policies in different contexts.
• Valuable tool for developing indicators on effective mathematics teacher

preparation for primary and secondary teachers.
• Valuable tool for designing mathematics teacher preparation policy for future mathematics primary and secondary teachers.
• TEDS-M is an in depth teacher education study that will produce heuristics for future in-depth studies of teacher preparation in all other school subjects.

For more information on the study please contact:

- **The IEA Secretariat at: department@iea.nl**
- **Study Co-director Maria Teresa Tatto at: mttatto@msu.edu**