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COMMISSION INTERNATIONALE DE L'ENSEIGNEMENT MATHÉMATIQUE

(THE INTERNATIONAL COMMISSION ON MATHEMATICAL INSTRUCTION)

LES MÉDAILLES DE LA CIEM FELIX KLEIN ET HANS FREUDENTHAL POUR 2003

La Commission internationale de l'enseignement mathématique (CIEM), fondée à Rome en 1908, a, pour la première fois de son histoire, créé deux médailles pour récompenser des contributions majeures à la recherche en didactique des mathématiques. La médaille Felix Klein, du nom du premier président de la CIEM (1908–1920), récompense l'œuvre d'une vie. La médaille Hans Freudenthal, du nom du huitième président de la CIEM (1967–1970), récompense un ensemble de travaux d'intérêt majeur sur un thème précis. Ces médailles seront décernées chaque année impaire et elles seront remises aux lauréats lors du Congrès international sur l'enseignement des mathématiques (ICME) suivant, les lauréats étant par ailleurs invités à faire une conférence à ce congrès.

Ces prix, qui récompensent un accomplissement majeur en didactique des mathématiques, ne visent pas uniquement à encourager la recherche didactique; ils veulent aussi contribuer au développement de standards de haut niveau pour cette recherche, à travers la reconnaissance publique de modèles. Ils sont attribués par un jury anonyme d'éminents chercheurs internationalement reconnus. Le jury des prix de 2003 était présidé par Michèle Artigue, professeur à l'Université Paris 7. La CIEM est fière d'annoncer les deux premiers lauréats des médailles Klein et Freudenthal:

◊ La médaille *Felix Klein* pour 2003 est décernée à Guy BROUSSEAU, professeur émérite à l'IUFM d'Aquitaine, pour l'œuvre majeure que constitue la théorie des *situations didactiques*, et pour l'ensemble des applications de cette théorie qu'il a développées pour l'enseignement et l'apprentissage des mathématiques.

◊ La médaille *Hans Freudenthal* pour 2003 est décernée à Celia HOYLES, professeur à l'Institut d'éducation de l'Université de Londres, pour l'ensemble de ses travaux concernant les usages de la technologie au service de l'enseignement des mathématiques.

Des présentations des travaux des deux lauréats sont fournies ci-après. La remise des médailles aura lieu lors de la cérémonie d'ouverture du congrès ICME-10, à Copenhague, le 5 juillet 2004 et les lauréats seront invités à présenter une conférence à ce congrès.

MÉDAILLE FELIX KLEIN 2003

La première médaille Felix Klein de la Commission internationale de l'enseignement mathématique (CIEM) est décernée au professeur Guy Brousseau. Cette médaille récompense la contribution essentielle que Guy Brousseau a apportée au développement de la didactique des mathématiques comme champ de recherche scientifique, à travers les travaux théoriques et expérimentaux qu'il a menés dans ce domaine pendant une quarantaine d'années. Elle récompense aussi les efforts permanents qu'il a déployés tout au long de sa carrière pour que ces recherches contribuent à l'amélioration de la formation mathématique des élèves et des enseignants.

Guy Brousseau, né en 1933, a commencé sa carrière comme instituteur en 1953. A la fin des années 60, après avoir obtenu une licence de mathématiques, il est entré à l'Université de Bordeaux. En 1986, il a obtenu un doctorat d'état ès sciences et, en 1991, il est devenu professeur d'université à l'IUFM d'Aquitaine qui venait d'être créé, où il a travaillé jusqu'en 1998. Il est actuellement professeur émérite à l'IUFM d'Aquitaine. Il est aussi docteur honoris causa de l'Université de Montréal (juin 1997) et de l'Université de Genève (juin 2004).

Dès le début des années 70, Guy Brousseau s'est imposé comme l'un des principaux chercheurs dans le champ tout nouveau de la didactique des mathématiques, et aussi comme l'un des plus originaux, affirmant avec conviction que ce champ devait être développé comme un champ de recherche spécifique, avec à la fois une recherche fondamentale et une recherche appliquée, mais aussi qu'il devait rester proche des mathématiques.

Sa contribution théorique essentielle au champ didactique est la théorie des situations didactiques, une théorie initiée au début des années 70 et qu'il a continué à élaborer avec une énergie sans faille et une exceptionnelle créativité jusqu'à aujourd'hui. A un moment où la vision dominante était une vision cognitive, fortement influencée par l'épistémologie piagétienne, il a affirmé avec force que ce dont le champ didactique avait besoin, ce n'était pas d'une théorie purement cognitive mais d'une construction qui permettrait de comprendre les interactions sociales entre élèves, enseignant et savoirs mathématiques qui se nouent au sein de la classe et conditionnent ce que les élèves apprennent et comment ils l'apprennent. Ce fut l'ambition de la théorie des situations didactiques qui a progressivement mûri pour devenir l'impressionnante et complexe construction qu'elle est aujourd'hui. Cette construction fut bien entendu un travail collectif mais chaque fois qu'il y eut des avancées notables, Guy Brousseau en fut la source.

Cette théorie, visionnaire par la façon dont elle sut intégrer, dès ses débuts, les dimensions épistémologiques, cognitives et sociales de l'apprentissage des mathématiques, a été une source constante d'inspiration pour de nombreux chercheurs, partout dans le monde. Ses principaux concepts, comme ceux de situations a-didactiques et didactiques, de contrat didactique, de dévolution et d'institutionnalisation, sont devenus largement accessibles, à travers la traduction des principaux articles de Guy Brousseau dans de

nombreuses langues et, plus récemment, à travers la parution en 1997 chez Kluwer du livre intitulé *Theory of Didactical Situations in Mathematics — 1970–1990.*

Bien que les recherches que Guy Brousseau a inspirées concernent aujourd'hui l'ensemble des niveaux d'enseignement, de l'école maternelle à l'université, ses contributions personnelles majeures concernent, elles, l'enseignement élémentaire, couvrant à ce niveau tous les domaines, du numérique et du géométrique jusqu'aux probabilités. Elles doivent beaucoup à la structure spécifique qu'est le COREM (Centre pour l'observation et la recherche sur l'enseignement des mathématiques), une structure qu'il a créée en 1972 et dirigée jusqu'en 1997. Le COREM a en particulier permis une organisation tout à fait originale des rapports entre recherche théorique et expérimentale.

Guy Brousseau n'a pas été seulement un chercheur inspiré et exceptionnel dans le champ de la didactique des mathématiques. Il a été aussi une personne qui a dédié sa vie professionnelle à ce champ, travaillant sans relâche à son développement, en France mais aussi dans de nombreux pays, soutenant la création de programmes doctoraux, aidant et dirigeant les travaux de nombreux chercheurs (il a ainsi dirigé plus de 50 thèses), contribuant de façon essentielle au développement des connaissances mathématiques et didactiques des étudiants et des enseignants. Il s'est impliqué fortement jusque dans les années 90 dans les activités de la CIEAEM (Commission internationale pour l'étude et l'amélioration de l'enseignement des mathématiques) dont il a été Secrétaire de 1981 à 1984. Sur le plan national, il a été, dès ses débuts, à la fin des années 60, un des piliers de l'expérience des IREM (Instituts de Recherche sur l'Enseignement des Mathématiques) et il a eu une influence décisive sur les activités et les ressources que ces instituts ont développées, depuis plus de trente ans, pour améliorer la formation mathématique des enseignants de l'école élémentaire.

MÉDAILLE HANS FREUDENTHAL 2003

La première médaille Hans Freudenthal attribuée par la Commission internationale de l'enseignement mathématique (CIEM) est décernée au professeur Celia Hoyles. Cette distinction récompense la contribution essentielle que Celia Hoyles a apportée à la recherche concernant les nouvelles technologies en didactique des mathématiques, tant sur un plan théorique qu'à travers le développement et le pilotage de projets nationaux et internationaux dans ce domaine, ayant pour but d'améliorer grâce à la technologie l'éducation mathématique des individus, des jeunes enfants aux adultes en situation de travail.

Celia Hoyles a étudié les mathématiques à l'Université de Manchester, y obtenant le prix Dalton récompensant le meilleur étudiant en mathématiques. Elle a commencé sa carrière comme professeur dans l'enseignement secondaire, avant de devenir assistante à l'Institut Polytechnique de North London. Après avoir obtenu un Master et un Doctorat en Éducation Mathématique, elle est devenue professeur à l'Institut d'éducation de l'Université de Londres en 1984.

Ses premiers travaux didactiques dans le domaine de la technologie, comme ceux de nombreux chercheurs, ont étudié le potentiel de LOGO pour l'apprentissage des mathématiques, et elle est rapidement devenue un chercheur de premier plan dans ce domaine. Un premier livre, publié en 1986, puis un second, édité en 1992, attestent de la productivité de cette recherche sur LOGO. Ces travaux furent suivis, en 1996, par la publication de l'ouvrage *Windows on Mathematical Meanings : Learning Cultures and Computers*, en collaboration avec Richard Noss, un ouvrage qui a permis une avancée

théorique majeure dans le champ, à travers des notions comme celle de *webbing* et de *situated abstraction*, des notions bien connues aujourd'hui des chercheurs quelles que soient les technologies sur lesquelles portent leurs travaux.

A partir du milieu des années 90, sa recherche sur les technologies a intégré les nouvelles possibilités offertes par les technologies de l'information et de la communication ainsi que l'évolution des rapports des enfants à la technologie. Elle a ainsi récemment co-dirigé successivement deux projets de recherche financés par la communauté européenne : le projet PLAYGROUND dans lequel des enfants de différents pays concevaient, construisaient et partageaient leurs propres jeux vidéos, et le projet WEBLABS en cours, dont le but est de concevoir et évaluer des laboratoires virtuels où, en collaboration mais à distance, des enfants de différents pays, élaborent et explorent des notions mathématiques et scientifiques. Chercheur internationalement reconnu dans le domaine de la technologie et de l'enseignement des mathématiques, elle a été récemment nommée par le Comité exécutif de la CIEM co-responsable de la nouvelle Étude de la CIEM sur ce thème.

La contribution de Celia Hoyles à la recherche en didactique des mathématiques s'étend bien au-delà de la technologie. Depuis le milieu des années 90, elle s'est également engagée dans deux autres importantes séries de travaux ; la première, consistant en une série de recherches sur la façon dont les élèves conçoivent la notion de preuve, a eu un rôle pionnier dans le développement de stratégies méthodologiques combinant des approches quantitatives et des approches qualitatives qui incluent une analyse longitudinale du développement. La seconde concerne les mathématiques utilisées en situation de travail et Celia Hoyles co-dirige actuellement un nouveau projet : *Techno-Mathematical Literacies in the Workplace*, qui ambitionne de développer cette recherche en mettant en œuvre et en évaluant une formation en situation de travail fondée théoriquement et utilisant divers nouveaux media.

Dans les années récentes, Celia Hoyles s'est trouvée de plus en plus engagée dans des activités de politique de l'éducation, avec des mathématiciens et des enseignants. Elle a été élue en octobre 1999 responsable du *Joint Mathematical Council of the UK* et elle est membre de l'*Advisory Committee on Mathematics Education* (ACME) qui représente l'ensemble de la communauté mathématique auprès du gouvernement pour les questions politiques liées aux mathématiques, de l'enseignement élémentaire à l'université. En 2002, elle a joué un rôle majeur dans l'élaboration du premier rapport rédigé par l'ACME pour le gouvernement sur la formation continue des enseignants de mathématiques ; elle a aussi contribué à la synthèse faite sur l'enseignement des mathématiques au Royaume-Uni pour les 14 à 19 ans. En reconnaissance de ses contributions, elle a récemment reçu l'Ordre de l'Empire Britannique pour « services rendus à l'éducation mathématique ».

Celia Hoyles fait partie de ces chercheurs en didactique des mathématiques qui, même lorsqu'ils s'engagent dans des questions théoriques, ne perdent pas de vue la pratique et qui, inversement, quand ils cherchent à faire progresser la pratique, n'oublient pas les leçons apprises de la théorie et de la recherche empirique. Son engagement au service de l'amélioration de l'éducation mathématique, dans son pays et au-delà, se retrouve dans chaque détail de son activité professionnelle variée et aux multiples facettes. Son enthousiasme et sa vision sont unanimement admirés par tous ceux qui ont été en contact direct avec elle. C'est grâce à des personnes comme elle, ayant un sens clair de leur mission et capables de bâtir des ponts entre recherche et pratique, tout en contribuant aux deux, que la communauté de didactique des mathématiques a acquis, au fil des ans, une identité mieux définie.

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COMMISSION INTERNATIONALE DE L'ENSEIGNEMENT MATHÉMATIQUE

(THE INTERNATIONAL COMMISSION ON MATHEMATICAL INSTRUCTION)

DOUBLE RENOUVELLEMENT À LA CIEM

par Bernard R. HODGSON

C'est à titre de commission de l'Union mathématique internationale (UMI) que la Commission internationale de l'enseignement mathématique (CIEM/ICMI) trouve le cadre légal définissant son existence. La CIEM repose donc sur l'UMI, ainsi que sur son Assemblée générale, en ce qui concerne certains gestes officiels tels l'élection des membres de son Comité exécutif ou encore la détermination des termes de son mandat. L'année 2002 a vu la CIEM connaître à la fois l'élection d'un nouvel Exécutif et l'adoption d'une version renouvelée de son mandat.

Lors de l'Assemblée générale de l'UMI tenue en août 2002 à Shanghai, les personnes suivantes furent élues au Comité exécutif de la CIEM pour la période du 1er janvier 2003 au 31 décembre 2006:

Président:	Hyman BASS	(États-Unis)
Vice-présidentes:	Jill ADLER	(Afrique du Sud)
	Michèle ARTIGUE	(France)
Secrétaire général:	Bernard R. HODGSON	(Canada)
Membres:	Carmen BATANERO	(Espagne)
	Nikolai DOLBILIN	(Russie)
	Maria Falk DE LOSADA	(Colombie)
	Peter L. GALBRAITH	(Australie)
	Petar S. KENDEROV	(Bulgarie)
	Frederick Koon-Shing LEUNG	(Hong Kong)

De plus, le Président de l'UMI, John BALL (Royaume-Uni), ainsi que son Secrétaire, Phillip GRIFFITHS (États-Unis), sont membres *ex officio* de l'Exécutif de la CIEM.

Le fait que le Comité exécutif comprend six membres (sans titre) résulte d'une égalité lors de l'élection. On trouvera des renseignements biographiques sur les membres du Comité dans le *Bulletin de la CIEM.*

Par ailleurs, la version précédente du texte décrivant le mandat de la CIEM remontait à 1986 et nécessitait une mise à jour. Le Comité exécutif a donc mené à compter de 2001 une série de consultations auprès de ses Représentants afin de recueillir des suggestions quant aux modifications à apporter à ses attributions telles que décrites dans ce texte. Il en est résulté une version renouvelée qui fut soumise pour fins de discussion au Comité exécutif de l'UMI. Lors d'une réunion tenue à l'Institut Henri-Poincaré, à Paris, en avril 2002 et à laquelle participaient le Président et le Secrétaire général de la CIEM, une version amendée des termes du mandat de la CIEM fut adoptée par le Comité exécutif de l'UMI.

Le nouvel énoncé de mandat de la CIEM figure ci-après (on trouvera la version de 1986 dans le *Bulletin de la CIEM* no. 47, décembre 1999, pp. 35–36). Les principaux amendements qui y ont été apportés sont les suivants:

- la notion de « membre de la CIEM » a été clarifiée: comme c'est le cas pour l'UMI, il s'agit de pays, et non d'individus;
- la notion d'« Assemblée générale » a été introduite, à laquelle le Comité exécutif de la CIEM doit faire rapport tous les quatre ans;
- de même le concept de « Représentants de la CIEM » fait maintenant partie de l'énoncé de mandat;
- le nombre de membres du Comité exécutif de la CIEM a été augmenté et la possibilité de cooptation de membres additionnels a été introduite;
- la notion de Groupe d'étude affilié à la CIEM a été formellement définie.

Il convient de remarquer que la CIEM possédait déjà une Assemblée générale, des Représentants ainsi que des Groupes d'étude affiliés, mais ceux-ci n'étaient pas mentionnés dans les descriptions officielles précédentes de ses attributions.

Quelques mots d'information sur la procédure de cooptation introduite dans le quatrième point ci-dessus. En réponse à des critiques souvent formulées dans le passé quant au rôle de l'Assemblée générale de l'UMI, le Comité exécutif de l'UMI a décidé de laisser une marge de décision plus grande à cette Assemblée générale. En ce qui concerne l'élection des Comités exécutifs de l'UMI et de ses commissions, l'Assemblée souhaitait recevoir une liste comprenant plus d'un candidat par poste à combler. La solution adoptée par l'Exécutif de l'UMI pour l'élection de 2002 fut d'avoir plus d'un candidat pour les postes autres que président, vice-président ou secrétaire (général). Afin de préserver les différents équilibres que le Comité exécutif sortant de la CIEM pourrait chercher à respecter, lors de l'identification des candidats à proposer à l'Exécutif de l'UMI pour l'élection du prochain Exécutif de la CIEM, la Commission a fait approuver par l'Exécutif de l'UMI cette possibilité de cooptation. Même si une telle procédure peut contribuer à augmenter le nombre de membres de l'Exécutif de la CIEM, elle a paru une solution adéquate afin d'aider à respecter les divers paramètres de représentativité que la CIEM vise à atteindre. Les nouveaux termes du mandat de la CIEM reflètent donc la procédure d'élection telle que mise en œuvre en 2002.

Un texte formel, tel celui qui suit, déterminant les attributions d'un organisme comme la CIEM est loin de pouvoir livrer la vraie nature de cet organisme. Il s'agit néanmoins d'un document auquel il faut savoir se référer dans certaines circonstances de la vie de la Commission. Le lecteur souhaitant commenter la nouvelle description

du mandat de la CIEM ou encore y proposer des améliorations futures est invité à entrer en contact avec le Représentant de la CIEM dans son pays, ou avec le Secrétaire général.

THE INTERNATIONAL COMMISSION ON MATHEMATICAL INSTRUCTION (ICMI)

TERMS OF REFERENCE (2002)

(*adopted by the Executive Committee of the International Mathematical Union at its meeting held at Institut Henri-Poincaré in Paris on April 12–13, 2002*)

1. The members of the International Commission on Mathematical Instruction (ICMI) consist of
   (*a*) those countries which are members of the International Mathematical Union (IMU), and
   (*b*) other countries which are co-opted, as specified in (7) below.
   The term "country" is to be understood as described in the Statutes of IMU.
2. The General Assembly of the Commission consists of
   (*a*) the members of the Executive Committee, as specified in (3) below, and
   (*b*) one Representative from each member country of ICMI, as specified in (5) below.
   The General Assembly of ICMI shall normally meet once in every 4 years, during the International Congress on Mathematical Education.
3. The Executive Committee of the Commission consists of the following members. *Elected by IMU:* nine members, including the four officers, namely, the President, two Vice-Presidents, and the Secretary-General. *Ex-officio members:* the outgoing President of ICMI, the President and the Secretary of IMU. *Co-opted members:* In order to provide for missing coverage or representation, the ICMI Executive Committee may co-opt up to two additional members.
4. In all other respects the Commission shall make its own decisions as to its internal organization and rules of procedure.
5. Appointment of the Representative to ICMI is the responsibility of the Adhering Organization of IMU, for those countries which are members of IMU, and of the Adhering Organization of ICMI, for those countries co-opted under item (7) below. Any Adhering Organization wishing to support or encourage the work of the Commission may create, or recognize, in agreement with its Committee for Mathematics in the case of a member country of IMU, a Sub-Commission for ICMI to maintain liaison with the Commission in all matters pertinent to its affairs. The Representative to ICMI, as mentioned in (2) above, should be a member of the said Sub-Commission, if created.
6. The Commission shall be charged with the conduct of the activities of IMU, bearing on mathematical or scientific education and shall take the initiative in inaugurating appropriate programmes designed to further the sound development of mathematical education at all levels, and to secure public appreciation of its importance. In the pursuit of this objective, the Commission shall cooperate, to the extent it considers desirable, with effective regional groups which may be formed spontaneously, within, or outside, its own structure.

7. The Commission may, with the approval of the Executive Committee of IMU, co-opt as members of ICMI countries that are not members of IMU, on an individual basis.
8. The Commission may approve the affiliation to ICMI of Study Groups, focussing on a specific field of interest and study in mathematics education consistent with the aims of the Commission. These Affiliated Study Groups are independent of ICMI, financially and otherwise, but they shall produce quadrennial reports to be presented at the General Assembly of ICMI. The Commission will cooperate, to the extent possible, with the work of the Study Groups, for example by regularly publishing information on their activities in the *ICMI Bulletin*.
9. The budget of the Commission shall be submitted to the Executive Committee of IMU and the General Assembly of IMU, for approval, at such times as may be determined by agreement between the Commission and the Executive Committee of IMU.
10. The Commission shall file an annual report of its activities with the Executive Committee of IMU, and shall file a quadrennial report at each regular meeting of the General Assembly of IMU.
11. At each regular meeting of the General Assembly of ICMI, the Commission shall file a quadrennial report of its financial situation and of its activities.

Procedures for the election of the Executive Committee of ICMI

The rules for the election of the Executive Committee of ICMI are similar to those for the election of the Executive Committee of IMU with the same Nominating Committee.

The existing Executive Committee of ICMI shall request proposals for the membership of the EC of ICMI from the Representatives to ICMI.

The EC of IMU shall request proposals for the membership of the EC of ICMI from the Committees for Mathematics, who shall consult the Representatives to ICMI for suggestions. The EC of IMU will conduct extensive consultations with the existing Executive Committee of ICMI before proposing slates to the Nominating Committee.

No person can be a candidate for more than one office.

(Reçu le 11 décembre 2003)

Bernard R. Hodgson

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COMMISSION INTERNATIONALE DE L'ENSEIGNEMENT MATHÉMATIQUE

(THE INTERNATIONAL COMMISSION ON MATHEMATICAL INSTRUCTION)

DISCUSSION DOCUMENT FOR THE FIFTEENTH ICMI STUDY

THE PROFESSIONAL EDUCATION AND DEVELOPMENT OF TEACHERS OF MATHEMATICS

1. Introduction

This document announces a new Study to be conducted by the International Commission on Mathematical Instruction (ICMI). The focus of this Study, the fifteenth to be led by ICMI, will be the professional education and development of mathematics teachers around the world. The premise of this Study is that the education and continued development of teachers is key to students' opportunities to learn mathematics. What teachers of mathematics know, care about, and do is a product of their experiences and socialization both prior to and after entering teaching, together with the impact of their professional education. This impact is variously significant: In some systems, the effects of professional education appear to be weak or even negligible, whereas other systems are structured to support effective ongoing professional education and instructional improvement. The curriculum of mathematics teacher preparation varies around the world, both because of different cultures and educational environments, and because assumptions about teachers' learning vary. Countries differ also in the educational, social, economic, geographic, and political problems they face, as well as in the resources available to solve these problems. A study focused on mathematics teacher education practice and policy around the world can provide insights useful to examining and strengthening all systems.

We recognize that all countries face challenges in preparing and maintaining a high-quality teaching force of professionals who can teach mathematics effectively, and who can help prepare young people for successful adult lives and for participation in the

development and progress of society. Systems of teacher education, both initial and continuing, are built on features that are embedded in culture and the organization and nature of schooling. More cross-cultural exchange of knowledge and information about the professional development of teachers of mathematics would be beneficial. Learning about practices and programs around the world can provide important resources for research, theory, practice, and policy in teacher education, locally and globally. Study 15, The Professional Education and Development of Teachers of Mathematics, is designed to offer an opportunity to develop a cross-cultural conversation about mathematics teacher education in mathematics around the world.

Because the professional education of teachers of mathematics involves multiple communities and forms of expertise, the Study also explicitly welcomes contributions from individuals from a variety of backgrounds. Mathematicians and school practitioners are particularly encouraged to submit proposals for contributions.

The Study will proceed in three phases: (a) the dissemination of a Discussion Document announcing the Study and inviting contributions; (b) a Study Conference, to be held in Brazil, 15–21 May 2005; and (c) publication of the Study Volume – a Report of the Study's achievements, products and results.

First is this Discussion Document, defining the focus of the Study and inviting proposals for participation in a Study Conference. We welcome individual as well as group proposals; focusing on work within a single program or setting, as well as comparative inquiries across programs and settings. In order to make grounded investigations of practice in different countries possible, we invite proposals in three formats: papers, demonstrations, and interactive work-sessions. Details are provided below.

Second, a Study Conference will be held in Brazil in May 2005, bringing together researchers and practitioners from around the world. The Conference will be deliberately designed for active inquiry into professional development of teachers of mathematics in different countries and settings. Some sessions will offer paper presentations; other sessions will engage participants in direct encounters with particular practices, materials and methods, or curricula.

Third, a Study Report – the Study Volume – will be produced, representing and reporting selected activities and results of the Study Conference and its products. This Report will be useful to the mathematics education community, as well as for other researchers, practitioners, and policymakers concerned with the professional education of teachers.

2. Why conduct a Study on the professional education of mathematics teachers?

Three main reasons underlie the decision to launch an ICMI study focused on teacher education. One reason rests with the central role of teachers in students' learning of mathematics, nonetheless too often overlooked or taken for granted. Concerns about students' learning compel attention to teachers, and to what the *work of teaching* demands, and what teachers know and can do. A second reason is that no effort to improve students' opportunities to learn mathematics can succeed without parallel attention to their *teachers' opportunities for learning*. The professional formation of teachers is a crucial element in the effort to build an effective system of mathematics

education. Third, teacher education is a vast enterprise, and although *research on mathematics teacher education* is relatively new, it is also rapidly expanding.

The timing is right for this Study. The past decade has seen substantial increase in scholarship on mathematics teacher education and development. A growing number of international and national conferences focus on theoretical and practical problems of teacher education. Publication of peer-reviewed articles, book chapters, and books about the development of teachers of mathematics is on the rise. Centers for research and development in teacher education exist increasingly in many settings. A Survey Team led by Jill Adler will report on the development of research on mathematics teacher education as part of the program at the Tenth International Congress on Mathematics Education (ICME-10) in July 2004 in Copenhagen. In addition, it is significant that the past decade has also included the launching of a new international journal (in 1996): the *Journal of Mathematics Teacher Education* (JMTE) is published by Kluwer, and edited by an international team of scholars. Seven volumes later, JMTE hosts a thriving international discourse about research and practice in teacher education.

Mathematics teacher education is a developing field, with important contributions to make to practice, policy, theory, and research and design in other fields. Theories of mathematics teachers' learning are still emerging, with much yet to know about the knowledge, skills, personal qualities and sensibilities that teaching mathematics entails, and about how such professional resources are acquired. The outcomes of teacher education are mathematics teachers' practice, and the effectiveness of that practice in the contexts in which teachers work. Yet we have much to learn about how to track teachers' knowledge into their practice, where knowledge is used to help students learn. And we have more to understand about how teacher education can be an effective intervention in the complex process of learning to teach mathematics, which is all too often most influenced by teachers' prior experiences as learners, or by the contexts of their professional work.

Study 15 aims to assemble from around the world important new work – development, research, theory, and practice – concerning the professional development of teachers of mathematics. Our goal is to examine what is known in a set of critical areas, and what significant questions and problems warrant collective attention. Toward that end, the Study aims also to contribute to strengthening the international community of researchers and practitioners of mathematics teacher education whose collective efforts can help to address problems and develop useful theory.

3. Scope and focus of the Study

This Study focuses on the initial and continuing education of teachers of mathematics. Our focus is the development of teachers at all levels, from those who teach in early schooling to those who teach at the secondary school. (In this Discussion Document, we use "primary" to refer to teachers of students of ages 5–11; "middle" to refer to ages 11–14, and "secondary" for ages 14 and older.) Teacher development is a vast topic; this study focuses strategically on a small set of core issues relevant to understanding and strengthening teacher education around the world.

The Study is organized in two main strands, each representing a critical cluster of challenges for teacher education and development. In one strand (*teacher preparation and the early years of teaching*), we will investigate how teachers in different countries are recruited and prepared, with a particular focus on how their preparation to teach

mathematics is combined with other aspects of professional or general academic education. In this strand, we will also invite contributions that offer insight into the early phase of teachers' practice. In the second strand (*professional learning for and in practice*), we will focus on how the gap between theory and practice is addressed in different countries and programs at all phases of teachers' development. In this strand, we will study alternative approaches for bridging this endemic divide, and for supporting teachers' learning in and from practice. This strand may be explored at any of the developmental stages – preservice, early years, and continuing practice – of teachers' practice. In both strands, we seek additionally to learn how teachers in different countries learn the mathematics they need for their work as teachers, and how challenges of teaching in a multicultural society are addressed within the professional learning opportunities of teachers.

Table 1 provides a graphic representation of the scope and focus of the Study. The table makes it plain that for Strand 1, the focus will be on the *preservice and early years* of teaching only; the Study will *not* focus on issues of recruitment, program structure and curriculum for *experienced* teachers. However, Strand II, focused on professional learning in and from practice, may be studied at all phases of teachers' development.

TABLE 1

SCOPE AND FOCUS OF THE STUDY

		PHASES OF TEACHER DEVELOPMENT	
		Initial teacher education (*preservice and early years of teaching*)	Continuing practice
STRANDS	Programs of teacher education (*recruitment, structure, curriculum, first years*)	YES	NO
	Professional learning for and in practice	YES	YES

4.1 STRAND I: TEACHER PREPARATION PROGRAMS AND THE EARLY YEARS OF TEACHING

This strand of the Study will examine a small set of important questions about the initial preparation and support of teachers in countries around the world, at the preservice stage, and into the early years of teaching. How those phases are structured and experienced varies across countries, as does the effectiveness of those varying structures. Questions central to the investigation of initial teacher preparation and beginning teaching will include:

a) STRUCTURE OF TEACHER PREPARATION. How is the preparation of teachers organized – into what kinds of institutions, over what period of time, and with what connections with other university or collegiate study? Who teaches teachers, and what qualifies them to do so? How long is teacher preparation, and how is it distributed between formal study and field or apprenticeship experience? How is the preparation of teachers for secondary schooling distinguished from that of teachers for the primary and middle levels of schooling?

b) RECRUITMENT AND RETENTION. Who enters teaching, and what are the incentives or disincentives to choose teaching as a career in particular settings? What proportion of those who prepare to teach actually end up teaching, and for how long? How do teachers' salaries and benefits relate to those of other occupations?

c) CURRICULUM OF TEACHER PREPARATION. The Study seeks to probe a small set of key challenges of teacher preparation curriculum and investigate whether and how different systems experience, recognize, and address these issues. Two such issues are:

- What is the nature of the *diversity* that is most pressing within a particular context – for example, linguistic, cultural, socio-economic, religious, racial – and how are teachers prepared to teach the diversity of students whom they will face in their classes?
- How are teachers prepared to know mathematics for teaching? What are the special problems of *subject matter preparation* in different settings, and how are they addressed? Is interdisciplinarity in teacher education commonplace, and if so, how is it managed? How do faculty in education interact with faculty in mathematics over issues of teacher education?

In addition, we invite proposals that identify and examine other specific central challenges for the curriculum of teacher preparation.

d) THE EARLY YEARS OF TEACHING. What are the conditions for beginning teachers of mathematics in particular settings? What supports exist, for what aspects of the early years of teaching, and how effective are they? What are the special problems faced by beginning teachers, and how are these experienced, mediated, or solved? What is the retention rate of beginning teachers, and what factors seem to affect whether or not beginning teachers remain in teaching? What systems of evaluation of beginning teachers are used, and what are their effects?

e) MOST PRESSING PROBLEMS OF PREPARING TEACHERS. Across the initial preparation and early years, what are special problems of teaching mathematics within a particular context and how are beginning teachers prepared to deal with these problems?

f) HISTORY AND CHANGE IN TEACHER PREPARATION. How has mathematics teacher preparation evolved in particular countries? What was its earliest inception, and how and why did it change? What led to the current structure and features, and how does its history shape the contemporary context and structure of teacher education?

Proposals for this Strand may offer descriptions accompanied by analyses of practices, programs, policies, and their enactment and outcomes. This is a scientific Study, and thus, we seek papers based on systematically gathered information and analyses.

In order to maximize the range of systems of teacher preparation about which we can learn through this Study, we seek proposals from a variety of countries. The Study's investigation will be improved if the countries represented on the Program differ in size, population diversity (language, culture, race, socioeconomic), performance in mathematics, centralization of curricular guidance and accountability, and level of societal and economic development.

Contributions to Strand I will be organized into a coherent section of the Study, with an overview and one or more analytic comparative commentaries to extend what can be learned from the individual cases and studies.

4.2 Strand II: Professional learning for and in practice

This strand of the Study adds substantive focus, in complement to the first. Whereas the first Strand examines programs and practices for beginning teachers' learning, the focus of the second relates to teachers' learning across the lifespan. This strand's central focus is rooted in two related and persistent challenges of teacher education. One problem is the role of experience in learning to teach; a second is the divide between formal knowledge and practice. Both problems lead to the central question of Strand II: How can teachers learn for practice, in and from practice?

Researchers and practitioners alike know that, although most teachers report that they learned to teach "from experience", experience is not always a good teacher. Prospective teachers enter formal professional education with many ideas about good mathematics teaching formed from their experience as pupils. Their experience of learning mathematics has often left them with powerful images of how mathematics is taught and learned, as well as who is good at mathematics and who not. These formative experiences have also shaped what they know of and about the subject. These experiences, along with many others, affect teachers' identities, knowledge, and visions of practice, in ways which do not always help them teach mathematics to students.

Moreover, teacher education often seems remote from the work of teaching mathematics, and professional development does not necessarily draw on or connect to teachers' practice. Opportunities to learn from practice are not the norm in many settings. Teachers may of course sometimes learn on their own from studying their students' work; they may at times work with colleagues to design lessons, revise curriculum materials, develop assessments, or analyze students' progress. In some countries and settings, such opportunities are more than happy coincidence; they are deliberately planned. In some settings, teachers' work is structured to support learning from practice. Teachers may work with artifacts of practice – videotapes, students' work, curriculum materials – or they may directly observe and discuss one another's work. We seek to learn about the forms such work can effectively take and what the challenges are in deploying them.

Strand II of the Study asks how mathematics teachers' learning may be better structured to support learning in and from professional practice, at the beginning of teachers' learning, during the early years of their work, and later, as they become more experienced. Central questions include:

a) *What sorts of learning seem to emerge from the study of practice?* What do teachers learn from different opportunities to work on practice – their own, or others'? In what ways are teachers learning more about mathematics, about students' learning of mathematics, and about the teaching of mathematics, as they work on records or experiences in practice? What seems to support the learning of content? In what ways are teachers learning about diversity, about culture, and about ways to address the important problems that derive from social and cultural differences in particular countries and settings?

b) *In what ways are practices of teaching and learning mathematics made available for study?* How is practice made visible and accessible for teachers to study it alone or with others? How is "practice" captured or engaged by teachers as they work

on learning in and from practice? (e.g., video, journals, lesson study, joint research, observing one another and taking notes)

c) *What kinds of collaboration are practiced in different countries?* How are teachers organized in schools (e.g., in departments) and what forms of professional interaction and joint work are engaged, supported, or used?

d) *What kinds of leadership help support teachers' learning from the practice of mathematics teaching?* Are there roles that help make the study of practice more productive? Who plays such roles, and what do they do? What contribution do such people make to teachers' learning from practice?

e) *What are crucial practices of learning from practice?* What are the skills and practices, the resources and the structures that support teachers' examination of practice? How have ideas such as "reflection", "lesson study", and analysis of student work been developed in different settings? What do such ideas mean in actual settings, and what do they involve in action?

f) *How does language play a role in learning from practice?* What sort of language for discussing teaching and learning mathematics – professional language – is developed among teachers as they work on practice?

Examining how some systems and settings organize teachers' work or their opportunities for continued learning close to the work of teaching can offer images and resources for grounding the ongoing development of professional practice educatively in practice.

5. Design of the Study

The Study on the Professional Education of Teachers of Mathematics is designed to enable researchers and practitioners around the world to learn about how teachers of mathematics are initially prepared and how their early professional practice is organized in different countries. In addition, the Study takes aim at an endemic problem of professional education – that is, how learning from experience can be supported at different points in a teacher's career, and under different circumstances. Toward this end, the study is designed to invite a variety of kinds of contributions for collective examination and deliberation at the Conference: research papers; program descriptions accompanied by analysis; conceptual work; demonstrations of practice; and interactive work on important common problems of teacher education and teacher learning.

The Study Conference will be organized to be different from a conventional research meeting. Although research papers will be part of the program, substantial time will be designed for direct engagement with artifacts and materials of practice, for critique and deliberation, and for collective work on significant problems in the field. The Program Committee will design the Conference using the proposals we receive, and add, as needed, commentators, activities, and other resources so that the Conference enables participants to work together at the meeting, and to generate new insights, ideas, and questions important to the professional education of teachers of mathematics around the world. We anticipate that participants will be organized into working groups that will meet regularly across the Conference, affording the opportunity for joint discussion, work, and possible plans for future collaborative activity. Working groups' ideas will be shared across the Conference; we will experiment with useful formats for such exchange of ideas generated in the course of the Conference. We also envision innovative plenary activities to provide common experiences for collective examination, discussion, and learning. Participation in the Study Conference is by invitation only, as is detailed below.

6. Call for contributions to the Study

The Study is designed to investigate practices and programs of mathematics teacher education in different countries, and to contribute to an international discourse about the professional education and development of teachers of mathematics. The International Program Committee (IPC) welcomes high-quality proposals from diverse researchers and practitioners who can make solid practical and scientific contributions to the Study. New researchers in the field are encouraged to submit proposals, as are those actively engaged in curriculum development for teacher education or professional development in any setting. Mathematicians – who play a crucial role in preparing and supporting teachers who are not specialists of the discipline – are urged to submit proposals and to participate in the Study. To ensure a rich and varied scope of resources for the Study, participation from countries under-represented in mathematics education research meetings is encouraged.

The conference will be a working one where every participant will be expected to be active. As is the normal practice for ICMI studies, participation in the Study conference is by invitation only, given on the basis of a submitted contribution. Proposed contributions will be reviewed and selections made based on the quality of the work, as well as to increase the diversity of perspectives offered, and the potential to contribute to the advancement of the Study. The number of participants invited to participate will be limited to approximately 120 people. The Study Volume, to be published after the conference in the ICMI Study Series, will be based on selected contributions and reports prepared for the conference, as well as on the outcomes of the conference. The *Study Website* (http://www-personal.umich.edu/~dball/icmistudy15.html), accessible also after the conference, will contain selected examples of practice in teacher education, or teachers' learning. A report on the Study and its outcomes will be presented at the 11th International Congress on Mathematical Education to be held in Mexico in 2008.

The International Program Committee for the Study invites submission of contributions on specific questions, problems or issues related to this Discussion Document. Proposals for contributions are invited for three formats: (a) papers; (b) demonstrations; (c) interactive work-sessions. Submissions should reach the Program Chairs *by e-mail* (at the addresses below) no later than October 15, 2004, but earlier if possible. All submissions must be in English, the language of the conference. To avoid confusion or loss of proposals, please label electronic attached files: <your surname_your given name>_ICMI15_prop.doc.

The contributions of those invited to the conference will be made available to other participants among the conference materials or on the conference website. However, an invitation to the conference does not imply that a formal presentation of the submitted contribution will be made during the conference or appear in the Study Volume published after the conference.

It is hoped that the conference will attract not only "experts" but also some "newcomers" to the field with interesting and refreshing ideas or promising work in progress. Unfortunately, an invitation to participate in the conference does not imply a financial support from the organisers, and participants should finance their own attendance at the conference. Funds are being sought to provide partial support to enable participants from non-affluent countries to attend the conference, but it is unlikely that more than a few such grants will be available.

Papers should be no longer than 2000 words and five single-spaced pages at most. Papers will be organized into thematic sessions by the Program Committee. Papers

should report on analysis of practices and programs of mathematics teacher education in particular settings, with attention to the main questions and foci of the Study as discussed above. For example, one paper might report on special practices of helping beginning primary teachers learn mathematics for teaching. Another might analyze how teachers in a particular setting work together on studying student work in geometry, and use that systematically to improve their teaching of geometry. Invited are: research reports; conceptual-analytic or theoretical papers grounded in examples of practice; and descriptions, accompanied by evidence appropriate to the claims of the paper. Camera-ready copy for inclusion in the materials for the Conference is required. All submissions should be in English, the language of the Study Conference, and should use Times 14-point font. Please also write a 200 word abstract that includes the main goal of your paper, demonstration, and worksession, and what its main elements will comprise. *Paper proposals without abstracts will not be reviewed.*

Demonstrations are sessions in which particular materials, approaches, or practices will be shared, examined, and critically discussed. We encourage sessions that will make as vivid as possible the materials, approaches, or practices to be demonstrated. Such sessions may engage participants actively in examples; may use artifacts of practice, such as videotapes, examples of teachers' work, or actual materials. For example, if a group of teachers studies videotapes of their teaching, a session might be designed to provide Conference participants with an opportunity to experience, firsthand, what opportunities for learning this might offer, as well as what some of the challenges might be. Proposals for demonstrations should include the goals of the session, what will be demonstrated and how it relates to the foci of the Study, a clear plan for the session itself, capacity for participation in the session, and any special requirements (technology, space, other) for the session. Proposals for demonstrations should be no longer than 1200 words, or three single-spaced pages, at most, and should additionally include a 500-word summary of the approach or practice that will be demonstrated, and what participants will do in the session. *Proposals without summaries will not be reviewed.* This summary must be in camera-ready form for inclusion in Conference materials, using Times 14-point font. If artifacts are used, they must be made accessible in English, the official language of the Study. Proposals for demonstrations should make clear the theoretical foundations of the practices to be demonstrated.

Interactive work-sessions are sessions in which a common problem of mathematics teacher education will be worked on by a group of researchers and practitioners attending the Conference. Proposals for work-sessions should include a clear description of the topic to be worked on, a clear explanation of the theoretical or conceptual issues to be addressed, a detailed plan for the work-session, the artifacts or materials that will be used to provide a context for the collective work, and who will lead the session. For example, an interactive worksession might be designed to center on how to assess teachers' learning; another might be structured to engage participants in the development of tasks that involve the use of mathematics in the work of teaching. Proposals for work-sessions should be no longer than 1200 words and three single-spaced pages at most, and should additionally include a 500-word summary of the problem and how the session will engage participants in work on the session. This summary must be in camera-ready form, with Times 14-point font, for inclusion in the Conference materials. *Proposals without summaries will not be reviewed.*

Proposals will be read and evaluated on the basis of the following criteria: (*a*) clear links to the Study's goals; (*b*) explicit fit with Strand I or II; (*c*) clearly structured and written, with attention to writing for others who may not share the same assumptions,

experience, or knowledge; (*d*) attention in the design of the paper, demonstration, or interactive worksession to the cross-cultural nature of the Study and the Conference. Successful proposals will be developed to be sensitive to the cross-cultural differences while also designed to profit from those other differences; (*e*) potential to contribute to the quality of the Study overall. This implies that some very good proposals may not be accepted if they do not add in the same way as others do to the overall scope and diversity of the Study. More details regarding formatting of proposals in all three categories will be available on the Study 15 website, which will be regularly updated with information about the Study and the Study Conference.

7. Study timeline

- Proposals for participation in the Study should reach the program co-chairs (see below) by October 15, 2004.
- Proposals will be reviewed and decisions made about inclusion in the Conference Program by November 20, 2004. Notifications about these decisions will be sent by November 30, 2004 to all those who submitted proposals.
- The Study Conference will be held in Águas de Lindóia, São Paulo, Brazil, from 15–21 May 2005.
- The Study Volume will be published by 2007, and a report of the Study and its results will be made at ICME-11 in 2008.

8. International program committee and contacts

The study is co-chaired by Deborah Loewenberg Ball and Ruhama Even. Their contact information is listed below. Please direct all inquiries concerning this Study to ***both*** co-chairs:

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The members of the International Program Committee (IPC) are: Jo Boaler (Stanford University, USA), Chris Breen (University of Cape Town, South Africa), Frédéric Gourdeau (Université Laval, Canada), Marja van den Heuvel-Panhuizen (Utrecht University, Netherlands), Barbara Jaworski (Høgskolen i Agder, Norway), Gilah Leder (La Trobe University, Australia), Shiqi Li (East China Normal University, China), João Filipe Matos (Universidade Lisboa, Portugal), Hiroshi Murata (Naruto University of Education, Japan), Jarmila Novotna (Charles University, Czech Republic), Aline Robert (IUFM de Versailles, France), Romulo Lins, *Chair of the Local Organising Committee* (State University of São Paulo at Rio Claro, Brazil), Bernard R. Hodgson, *ex officio*, *Secretary-General of ICMI* (Université Laval, Canada), Hyman Bass, *ex officio*, *President of ICMI* (University of Michigan, USA).