

Journal of Mathematics Education at Teachers College

Fall – Winter 2010

A CENTURY OF LEADERSHIP IN
MATHEMATICS AND ITS TEACHING

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The *Journal of Mathematics Education at Teachers College* is a publication of the
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This issue's cover and those of future issues will honor past and current contributors to the Teachers College Program in Mathematics. Photographs are drawn from the Teachers College archives and personal collections.

This issue honors Dr. Alexander P. Karp, an Associate Professor in the Program in Mathematics at Teachers College. A native of St. Petersburg, Russia who is the author of more than one hundred publications including textbooks used throughout Russia, Professor Karp represents Teachers College at meetings and conferences throughout the world as well as through his role as managing editor of the *International Journal for the History of Mathematic Education*.

Former Teachers College Professor and Mathematics Education Chair, Howard Franklin Fehr, was among the most influential mathematics educators of his era. Through his many international contacts, he was the organizer of conferences, projects, and publications including the Congresses of Mathematics Education, a seminal conference on Needed Research in the field, and curriculum initiatives including the Secondary School Mathematics Curriculum Improvement Study.

Aims and Scope

The *JMETC* is a re-creation of an earlier publication by the Teachers College Columbia University Program in Mathematics. As a peer-reviewed, semi-annual journal, it is intended to provide dissemination opportunities for writers of practice-based or research contributions to the general field of mathematics education. Each issue of the *JMETC* will focus upon an educational theme. Themes planned for the 2011 issues are: *Mathematics Curriculum* and *Technology*. *JMETC* readers are educators from pre K-12 through college and university levels, and from many different disciplines and job positions—teachers, principals, superintendents, professors of education, and other leaders in education. Articles to appear in the *JMETC* include research reports, commentaries on practice, historical analyses and responses to issues and recommendations of professional interest.

Manuscript Submission

JMETC seeks conversational manuscripts (2,000-2,500 words in length) that are insightful and helpful to mathematics educators. Articles should contain fresh information, possibly research-based, that gives practical guidance readers can use to improve practice. Examples from classroom experience are encouraged. Articles must not have been accepted for publication elsewhere. To keep the submission and review process as efficient as possible, all manuscripts may be submitted electronically at www.tc.edu/jmetc.

Abstract and keywords. All manuscripts must include an abstract with keywords. Abstracts describing the essence of the manuscript should not exceed 150 words. Authors should select keywords from the menu on the manuscript submission system so that readers can search for the article after it is published. All inquiries and materials should be submitted to Ms. Krystle Hecker at P.O. Box 210, Teachers College Columbia University, 525 W. 120th St., New York, NY 10027 or at JMETC@tc.columbia.edu

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Call for Papers

The “theme” of the spring issue of the *Journal of Mathematics Education at Teachers College* will be *Mathematics Curriculum*. This “call for papers” is an invitation to mathematics education professionals, especially Teachers College students, alumni and friends, to submit articles of approximately 2000-2500 words describing research, experiments, projects, innovations, or practices related to mathematics curriculum. Articles should be submitted to Ms. Krystle Hecker at jmetc@tc.edu by January 1, 2011. The spring issue’s guest editor, Nicholas Wasserman, will send contributed articles to editorial panels for “blind review.” Reviews will be completed by February 1, 2011, and final drafts of selected papers are to be submitted by March 1, 2011. Publication is expected in mid-April, 2011.

Call for Volunteers

This *Call for Volunteers* is an invitation to mathematics educators with experience in reading/writing professional papers to join the editorial/review panels for the spring 2011 and subsequent issues of *JMETC*. Reviewers are expected to complete assigned reviews no later than 3 weeks from receipt of the blind manuscripts in order to expedite the publication process. Reviewers are responsible for editorial suggestions, fact and citations review, and identification of similar works that may be helpful to contributors whose submissions seem appropriate for publication. Neither authors’ nor reviewers’ names and affiliations will be shared; however, editors’/reviewers’ comments may be sent to contributors of manuscripts to guide further submissions without identifying the editor/reviewer.

If you wish to be considered for review assignments, please request a *Reviewer Information Form*. Return the completed form to Ms. Krystle Hecker at jmetc@tc.edu or Teachers College Columbia University, 525 W 120th St., Box 210, New York, NY 10027.

Looking Ahead

Anticipated themes for future issues are:

Spring 2011	Curriculum
Fall 2011	Technology
Spring 2012	Evaluation
Fall 2012	Equity
Spring 2013	Leadership
Fall 2013	Modeling
Spring 2014	Teaching Aids
Fall 2014	Special Students

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A Recipe for Success: A Comparative View of Mathematics Teacher Education in Finland and Singapore

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Finland and Singapore are both nations that have excelled in mathematics on international assessments, such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS). Evidence of Finland's educational success emerged with the outcome of the first PISA study in 2000. Since then, many have looked to Finland for explanations. Within the field of education, many believe the reasons for the success are primarily pedagogical, referring to Finland's excellent teachers and high-quality teacher education. Similarly for Singapore, the consistency in the country's good outcome in the TIMSS study has brought the world's attention to this small island country. This article explores the similarities and differences in the educational systems of these two countries.

When looking for successful approaches to pursue in education, it may be helpful to look abroad, particularly to those countries that perform well in international assessments of mathematics. The inspection of teacher education, certification policies, and practices in Finland and Singapore reveals some surprising similarities as well as many differences across the countries. This comparison focuses on the teacher education and development process in two countries whose students have demonstrated relatively high proficiency in international studies. While data on teacher preparation alone are not sufficient to explain student achievement, it is interesting to see how those outstanding countries train their teachers. Both PISA and TIMSS evaluate students' mathematical knowledge. The main difference between the studies has to do with the type of content and skills being measured. TIMSS focuses on curricular material taught in schools, while PISA has a greater focus on problem solving, evaluation of information, statistics, and probability (NGA, CCSSO, and Achieve, 2008).

Finland

The Programme for International Student Assessment (PISA) is a collaborative effort on behalf of the OECD countries to assess the knowledge and skills of 15-year-old students. The study is conducted every three years, beginning in 2000. It is built on the "best possible" measures to ensure just comparison between performance of different countries and cultural regions (Björnsson, Halldórsson, & Ólafsson, 2004). Since the first PISA study in 2000, Finland has consistently been one of the top countries when it comes to student achievement in each cycle, and in all three domains of the study: mathematical literacy, scientific literacy, and reading. The good outcome of Finnish students in the PISA study is likely brought on

by many social and cultural factors and may not be caused solely by Finland's good teachers. That being said, this accomplishment is a strong indicator that Finland is on the right track when it comes to teacher education (Simola, 2005).

The Finnish School System

Finland established compulsory education in the 1920s, and the current comprehensive school system has been in place since the 1970s. The comprehensive school system in Finland consists of 9 years of compulsory education for all Finnish children starting at the age of seven. For children five and six years of age, there is an elective pre-school education that over 90% of Finnish children attend. The comprehensive school is followed by upper secondary school (not mandatory but available to all) and then universities and other institutions of higher education. The expense of education in Finland, at all levels, is mainly carried by taxes (Björkqvist, 2006). As well as being free, education is well supported, where teachers and students are provided with a good working environment. Teachers and students have access to technology, and teachers have little restrictions when it comes to educational material (Malaty, 2006).

Teacher Education in Finland

Since 1979, all Finnish teacher education has been the responsibility of universities, both primary teacher education and secondary teacher education. All teachers are required to hold masters degrees in order to teach in comprehensive school. Teaching in 1st–6th grade is carried out by class teachers, and teaching in 7th–9th grade and upper secondary education is done by subject teachers. Primary teacher education is by far the most popular field

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in higher education in Finland, where only 15% of applicants are admitted. Secondary subject teaching in Mathematics and Physics remains less popular, as in many other countries (UNESCO, 2003).

Mathematics secondary teacher training is offered by mathematics departments of universities as well as by faculties of education. Students need a Bachelor's degree plus an M.Sc. in which mathematics is a major or a minor. Becoming a mathematics secondary school teacher is a five- to six-year process, where students complete their studies by writing a Masters thesis. Education faculty of universities are responsible for all education of primary school teachers but only for the pedagogical studies of subject teachers. Mathematical content knowledge is provided by the mathematics departments.

In-service teacher education in Finland is well organized to support the individual professional development of teachers. In-service education is provided by the National Board of Education and the Mathematical Subjects Teachers Association, as well as in other organizations. Each university has a center for in-service continuing education, and each province has a Summer university where teachers can further their education (Malaty, 2006).

The interest in the teaching profession in Finland is substantial. Being a teacher is held to high prestige by the Finnish society, and teaching is considered a noble profession. One contributing reason is that Finnish schools have a pleasant work environment where teachers have the respect of their students as well as the respect of the community. This respect for teachers and the prestige of the teaching profession in Finnish society seem to outweigh the fact that Finnish teachers only have an average salary (Simola, 2005). Those who enter the teaching profession usually remain there for the rest of their professional lives.

Singapore

The Trends in International Mathematics and Science Study (TIMSS) is sponsored by the International Association for the Evaluation of Educational Achievement. The study tests 4th and 8th grade students' knowledge and skills in mathematics and science. TIMSS is conducted every four years, most recently in 2007. Singapore's performance in the TIMSS mathematics assessment has put a spotlight on that small city state (NGA, CCSSO, & Achieve, 2008).

The Singaporean School System

The Ministry of Education in Singapore provides the curriculum and assessment guidelines for the educational system and controls the administration of publicly funded schools. Textbooks and teaching material are supervised

by the Ministry of Education, and schools receive substantial funds to buy books and material needed. The compulsory education system in Singapore is mainly publicly funded, although since the year 2005, there are three privately funded schools in Singapore (TIMSS & PIRLS International Study Center, 2008).

After disappointing result on the Second International Study in the mid-1980s, the Singaporean Ministry of Education undertook a reform of the science and mathematics curriculum (NGA et al., 2008). Primary education is six years, and at the end of it, all students need to pass the Primary School Leaving Examination (PSLE). The results from the PSLE are used to place students in secondary education for the next four or five years. At the end of general education, students have the option of postsecondary education. The educational system is ability-based, and students can take a mix of standard- or foundation-level courses depending on their ability in each subject (TIMSS & PIRLS International Study Center, 2008).

Mathematics is a core subject in the Singaporean curriculum, and every student must take it at both primary and secondary level. The time devoted to mathematics ranges from 15% of school time in 1st grade to 27% in 5th and 6th grade. From upper primary level (grade 5) and on, students have specialized mathematics teachers. This importance of mathematics and science is further noticed in mathematics and science fairs and competitions as well as in the establishment of Centers of Excellence in Mathematics and Science (TIMSS & PIRLS International Study Center, 2008).

Teacher Education in Singapore

The Singaporean Ministry of Education oversees teacher education and the teacher certification process, as well as determining the curriculum content for the teacher programs (Wang, Coleman, Coley, & Phelps, 2003). One institution prepares teachers in Singapore, the National Institute of Education (NIE). Teacher education was upgraded to university level in the 1990s, and the NIE was founded in 1991 as part of the Nanyang Technological University (Deng & Gopinathan, 2003). NIE offers pre-service teacher education, professional development, and conducts educational research. NIE provides four major directions: Initial Teacher Preparation Program, Graduate Programs and Research, Academic Computing and Information Services, and Corporate Planning and Development. Students can choose between three teaching tracks in the initial teacher preparation program. These tracks depend on their interest in teaching at the primary, secondary, or junior college level. The teacher preparation program provides students with specialized knowledge in at least one academic discipline (National Institute of Education: Singapore).

To become a teacher in Singapore, students must go through a rigorous selection process. Teacher education is studied at the graduate level. The prospective teachers come from the top third of each cohort and are mainly university graduates. To teach at the primary level, teachers must be able to teach a variety of subjects, including English, mathematics, and science. To teach at the secondary level, teachers specialize in one or two subjects. Mathematics teachers in secondary schools and junior colleges must have a university degree in the subject (TIMSS & PIRLS International Study Center, 2008).

A part of the teacher education is a compulsory practicum and school experience for at least 10 weeks, under the supervision of experienced teachers and professors. To bring practical experience to NIE, school principals and former school teachers have been hired by NIE to be involved in the teachers' preparation. This extensive practical experience is thought to help pre-service teachers link theory and practice (Deng, 2004). All prospective teachers must complete a graduate program for initial certification (Wang et al., 2003). The only way to get a teacher certification in Singapore is by the traditional teacher education programs of NIE. Once a teacher receives a Teacher certification, it is valid for life (Wang et al., 2003).

The Ministry of Education hires all teachers. Hiring requirements include an appropriate university degree, subject matter specialization, English language skills, communication skills, and proper attitude (Wang et al., 2003). Singaporean teachers get 100 hours paid leave per year, if they desire, for continuing education or retraining (Wang et al., 2003).

Similarities and Differences in Education in Finland and Singapore

Since the mid 1980s, both Finland and Singapore have gone from average student performance to excellence in international comparison of recent times. In both countries, entrance into teacher education programs is highly selective such that only the best students are admitted. All teacher education is on the graduate level, and emphasis is placed on content knowledge for mathematics teachers. Both Finland and Singapore offer intensive academic support to students in need (NGA et al., 2008). The educational systems in Singapore and Finland aim to provide at least 10 years of quality general education for all children.

Even though Singapore and Finland have about the same population size, the makeup of the population is very different. The Finnish population is very homogeneous, while Singapore's population is diverse, made up of Chinese, Malays, Indians, Caucasians, and Asians of various ethnicity. There is also a vast difference in the

density of the population: Singapore has 18200 persons per square mile and Finland only 41 persons per square mile.

In Singapore, there is an emphasis on mathematics education, and a portion of children's school time is devoted to the subject from an early age. Mathematics fairs and competitions are used to generate interest among students to participate and excel in mathematics. A special program is offered to the intellectually gifted, structured to develop their leadership and capacities for creative and critical thinking. The educational system is ability-based, with students streamed according to their performance. In 6th grade, students are tested and divided into five categories, depending on their learning abilities and interests (TIMSS & PIRLS International Study Center, 2008).

In Finland, however, there is more emphasis on unity, where everyone has the same opportunity to do well. This is reflected in the Basic Education Act, that says: "The instruction has to promote equality in society and pupils' abilities to participate in education and to otherwise develop themselves during their lives." For that same reason there is no selecting, tracking, or streaming students during their basic education in Finnish schools (CFBT Educational Trust, 2004).

The term "benchmarking" is frequently seen these days. According to the American Productivity and Quality Center: "Benchmarking is the practice of being humble enough to admit that someone else has a better process and wise enough to learn how to match or even surpass them" (NGA et al., 2008). It could be beneficial for the United States to look abroad and see how things are done in other countries, both to see where others succeed as well as learn from their mistakes. In the case of Finland and Singapore, it is not enough to look at their performance score in international studies; it is also necessary to see what factors contributed to their success. The United States could benefit from Finland's and Singapore's excellent teacher education and their approach to low-achieving students. In Finland and Singapore, all teacher education is quality education, where the institutional structure of the education system and teacher training make overall management and quality standards for teachers easier to uphold. The United States should be concerned about the unequal distribution of their well trained teachers across schools and school districts. They should strive toward implementing quality teacher training programs in all states for all teachers.

Elements like respect for teachers and cultural importance of mathematics are hard to transfer from one country to another. Such modifications take time and require a change of heart both in society and within the teaching profession. Put in the words of Alfred Nobel, "it is not sufficient to be worthy of respect in order to be respected"; however, being worthy is a good start.

A RECIPE FOR SUCCESS

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