

Journal of Mathematics Education at Teachers College

Fall – Winter 2010

A CENTURY OF LEADERSHIP IN
MATHEMATICS AND ITS TEACHING

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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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The Bologna Effect

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As the first decade of the groundbreaking European higher education reformation known as the Bologna Process comes to a close, its impact on the field of mathematics is significant in many ways. Mathematics degrees and programs are changing across Europe, and in some cases, with serious side effects. On the other hand, there have been considerable increases in the percentage of international students, who tend to major in mathematics and mathematics-related fields, attending European universities. The effects of the Bologna Process extend far beyond Europe, and while the changes implemented by the Bologna Process are seemingly positive for European higher education, this could prove disadvantageous for U.S. higher education. This article discusses the impact of the Bologna Process on the field of mathematics in Europe, and how the Bologna Process affects the U.S. in the global competition to attract international students.

Background

In 1999, ministers of education from twenty-nine European nations met at the University of Bologna in Italy with the purpose of creating a European Higher Education Area (EHEA) (Gaston, 2010). This EHEA was not intended to be a single European system of higher education, but instead many national systems of higher education presenting closely comparable structures (Gaston, 2010). This means that individual countries are responsible for putting Bologna into place, and this allows them to maintain their individuality, local languages, cultures, and heritage (Bologna Process, 2009). This also means that the Bologna Process will be implemented differently among countries, universities, and programs. So the Bologna Process in France looks very different from the Bologna Process in Germany, and the Bologna Process at Bielefeld University looks different from the Bologna Process at the University of Oslo (Bologna Process, 2009). Even within a university, the Bologna Process in a mathematics department can be different from the Bologna Process in a humanities department (Bologna Process, 2009).

There were many reasons that an EHEA was desired, e.g., an EHEA would make it easier for students to move between the participating European countries for purposes of further study or employment. The primary impetus behind having an EHEA was due to the ministers' belief in the role that higher education played in supporting European economic growth and the international resurgence of the European Continent (Bologna, 1999).

The twenty-nine ministers signed the Bologna Declaration into effect to begin the process of establishing an EHEA. In order to establish this EHEA, it was determined that six action-lines (objectives) would need to be met and that each country would undergo a decade-long process, referred to as the Bologna Process, to achieve these six action lines: create easily readable and

comparable degrees through the adoption of a diploma supplement, organize higher education into two main cycles—undergraduate and graduate, manage educational credentials through a recognized system of credits, encourage mobility across national borders for students and faculty, develop a stronger commitment to quality assurance based on comparable criteria and methodologies, and promote “the necessary European dimensions in higher education,” especially in terms of “curricular development, inter-institutional cooperation, mobility schemes and integrated programs of study, training and research” (Bologna, 1999). The ministers also agreed to meet biennially in different nations to discuss the progress being made on the action lines.

By 2003, four more action lines had been added: provide access to lifelong learning, endorse a social dimension to expand access to higher education and make the Bologna Process more inclusive of students and faculty at the institutional level, enhance the “attractiveness of European higher education to students from Europe and other parts of the world,” and change from two main cycles to three main cycles to include doctoral programs (Gaston, 2010).

Currently, there are forty-seven European nations participating in the Bologna Process, and it has been decided that a second decade of the Bologna Process is necessary (Gaston, 2010). In this second decade, efforts to accomplish fully the ten action lines from the first decade of the Bologna Process will continue.

The Bologna Process has affected almost every field and every aspect of higher education in Europe. *Trends 2010*, a report that quantitatively and qualitatively analyzes the effects of the Bologna Process from a higher education institution perspective, found that of the institutions surveyed, 78% indicated that the Bologna Process had played a highly important role in their institutional strategy over the past three years (Sursock & Smidt, 2010).

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Perhaps the change that is most felt by students and professors is the harmonization of degree structures. Prior to the Bologna Process, each nation had their own degree structure, e.g., in Germany, students would earn a Magister or Diplom in about five to six years, and then a doctorate after another three to four years. However, in Italy, students would earn the Laurea in roughly four to six years, and a doctorate thereafter (Assefa & Sedgwick, 2004). But then, in Hungary, students would earn either a three- to four-year bachelor's degree at a college or a 4-5-year master's degree at a university, etc. (Connelly, 2010).

This was problematic, though, because in many cases, a degree in one country was not considered equivalent to a degree in another country for educational and/or employment purposes. Another shortcoming of the old system was that the lengthy first degrees, which could take as long as seven years to complete in some countries, led to many students abandoning their studies before graduating (Assefa & Sedgwick, 2004).

Presently, thirty-seven of the participating nations of the Bologna Process now have a three-cycle degree structure (Surssock & Smidt, 2010). This three-cycle degree structure usually takes the form of what is known as the 3-5-8 system, where students earn a bachelor's degree after three years, a master's degree two years after the bachelor's degree, and a doctorate three years after the master's degree. There are some cases where students earn a bachelor's degree in four years and a master's degree after one additional year (Knights, 2010). While there are clear benefits to this change in degree structure, there have been some downsides as well.

The Effects of Bologna in Europe

One downside of the Bologna Process involves retention. It had been believed that having shorter degrees would result in decreased dropout rates. While there has been a decrease in dropout rates in the humanities and language programs, this has not been the case in the mathematics programs. In a study released by the Higher Education Information System (HIS), it was found that in Germany, in mathematics (and mathematics-related fields), there was an increase in dropout rates. Currently, about 20% of students who begin a program will fail to complete it; however, for students of mathematics (and mathematics-related fields), that number jumps to more than 30% (Fox, 2010).

HIS researcher, Heublien, believes this is due to the new bachelor's degrees requiring students to pass very difficult exams in the first semesters, which does not allow them time to make up for holes in their knowledge (Fox, 2010). Being required to pass difficult exams early on is quite a change for mathematics programs in Germany; however, another modification regarding exams could also be a contributing factor to the increased dropout rates. A

graduate-level mathematics student at one of Germany's research universities discussed how the Bologna Process changed exam-taking in his department. "Before Bologna, we would take an oral exam which was the only thing that counted toward our final grade. Once we felt prepared, we would make arrangements with our professor and schedule it. Our oral exam didn't have to be taken by the end of the semester ... just whenever we felt we were ready to take it. So it could be another semester or even another year before we'd take our exam.... I know of a student who waited two years to take an oral exam.... But with Bologna, most professors stopped doing oral exams and switched to written exams."

Another issue raised by the Bologna Process is whether or not the introduction or changes made to the first degrees have actually devalued the first degrees, especially in terms of employability. In *Trends 2010*, only 15% of European universities and 45% of other European higher education institutions surveyed indicated that they expect their students to enter the labor market after completion of the bachelor's degree (Surssock & Smidt, 2010). Also, roughly 40% of institutions visited by Trends 2010 researchers revealed significant concerns regarding the bachelor's degree (Surssock & Smidt, 2010).

In Spain, students complained of the pressure they feel to complete an often expensive master's degree to obtain the same recognition and job prospects they would formerly have earned with a first degree (Warden, 2008). In Germany, when the bachelor/master system was first introduced, students were given an option between the new degree system and the old one. Many students chose the old degree system because they felt it would be better for them for employment purposes. A recent mathematics graduate explained, "I started here in 2002 with the first class for the bachelor's but I switched to the Diplom, because it seemed like employers didn't really know how to look at the bachelor's." It is apparent that there are countries in which the bachelor's degree has made little or no impact, and the master's degree remains the basic entry-to-labor market qualification (Surssock & Smidt, 2010). This is something that participating nations hope to rectify during the second decade of the Bologna Process.

The new degree structure also has caused some concern pertaining to curricula, such as modification of mathematics education programs. For example, in Hungary, of all the students who receive a Bachelor of Science in mathematics, about only one-third are supposed to go on to a master's degree, whereas the other two-thirds are supposed to enter the work force (Connelly, 2010). All prospective teachers above the nursery or early primary school levels will be required to earn a master's degree (Connelly, 2010).

As one university mathematics professor explained, "So this is sheer nonsense! Whoever wants to become a teacher *must* cut his studies after three years, *must* apply to a new position, and if he or she gets it, or not. And only

after five years will become a teacher. And as a rule, the future teachers have to learn the same thing from mathematics in these first three years as the future mathematicians. Which is again nonsense! There are things which are needed for a future mathematician which are *not* needed for a future teacher—very abstract new parts of mathematics. There are things which are needed for a future teacher—how to make good high school problems—which is not needed for a future mathematician. So their needs are definitely different. Previously, we had separate paths for the future teachers and the future mathematicians from the very beginning. Now, in the first year, in principle, it is absolutely the same for everybody ... so this Bologna was a disaster!” (Connelly, 2010, p. 104)

In Germany, secondary mathematics teachers also are required to earn both the bachelor’s and master’s degrees; however, Germany had a different dilemma, which involved whether or not prospective secondary teachers would take mathematics courses at the master’s level. Germany decided to address this dilemma by attempting two different methods at two different universities to determine which method worked best for students. At the first trial university, the three possible ways to earn the bachelor’s and master’s degrees required all mathematics courses to be taken during the bachelor’s degree, which meant that students would not take any mathematics courses while earning their master’s degree. The second trial university allowed students to take mathematics courses while earning their master’s degree, which proved to be better for students. A graduate student of the first trial university said, “We tried our way, but a lot of people complained that it didn’t make sense to go two years without math, and then step into a classroom and teach math. The better way won, and that’s how it should be. All universities will now try this way, and we will switch to this way within the next two years.”

And while things haven’t gone as smoothly as hoped for the participating nations of the Bologna Process, they have shown that they are committed to getting things right; hence, the call for a second decade of the Bologna Process. A few nations have acknowledged that some changes have impacted students negatively, and they are working to rectify this. For example, in Germany, after thousands of students protested in cities across the country against reforms to the higher education system, the country’s state education ministers pledged to rework the new format (Mara, 2009).

The Competition for International Students

Seemingly, Europe still has some adjustments to make regarding its new degree structure; however, it has made significant strides toward its goal of enhancing the attractiveness of European higher education to

international students. This has included: a call for countries to designate a national organization to take charge of increasing international attractiveness, for governments to provide social security cover and grant visas and work permits for staff that would help with enhancing attractiveness, the funding of a two million euro Global Promotion Program by the European Commission with the purpose of acting as an umbrella European brand, and a three-fold increase since 2002 in the number of master’s degree programs being taught in English (the European universal second language) (Bologna Process, 2009).

Countries such as Germany have created a German Excellence Initiative, where it earmarked nearly two billion euro for five-year grants to “make Germany a more attractive research location” (Gaston, 2010, p. 113). British universities have also received the full backing of the British government in their recruitment efforts, as Tony Blair made this one of his early personal priorities, so much so that he set up a so-called Prime Ministerial Plan in 1999. Its aim was to bring in 50,000 more students to the United Kingdom by 2005—and this target was met and exceeded (Flather, 2006). It is clear that there is a fierce global competition for international students at hand, and it is a competition that the U.S. is losing.

Although the U.S. currently receives the largest number of foreign students, its share dropped from 25% percent of all foreign students in 2000 to 20% in 2006 (Douglass & Edelstein, 2009), while there has been an increase in percentage share of international students in European countries, e.g., Germany and France (Malley, 2007).

A decrease in the number of international students hurts the U.S. for a number of reasons. First, international students contribute significantly to the U.S. economy. During the 2008-2009 academic year, international students spent \$17.8 billion in the U.S., most of which came from sources outside the U.S. (Blaylock, 2010). Second, international students make up a significant portion of those earning mathematics degrees (National Science Foundation, 2002). Mathematics commands special attention because of its importance to industrial innovation (National Science Foundation, 2002), which affects the economy of a nation and the quality of life of its citizens.

The U.S. has had declining numbers of its own citizens who go into mathematics, and international students help compensate for this decline. This is important, because it is common for a graduated foreign student to stay in the U.S. and begin employment in their field. In 1999, the percentage of foreign-born individuals with doctorates in mathematics that were part of the U.S. workforce had increased in all sectors (National Science Foundation, 2002). Among the U.S. scientists and engineers with doctorates in mathematics, 30% had been born abroad. Of those with mathematics doctorates working in industry, more than one-third were foreign-

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born. In academia, the percentage of foreign-born individuals possessing U.S. Ph.D.'s that are full-time mathematics faculty members increased considerably from 16% in the 1970s to 28% by 1999 (National Science Foundation, 2002).

As the U.S. continues with its rising tuition rates and increased barriers to enter the country, its percentage of foreign students will continue to decrease, whereas the European nations, which have minimal or no tuition fees, will increase their share of foreign students. Victor C. Johnson, senior adviser for public policy at NAFSA: Association of International Educators, discussed how the recent slowdown points to the need for a national strategy for international-student recruitment. "We don't want to wake up one day and find out that, because we have not adopted a national policy, we're no longer competitive," Johnson says. "We need to respond before it's too late to do something" (Batalova, 2007). Hopefully, the U.S. will respond.

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