

# 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](http://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. 120<sup>th</sup> St., New York, NY 10027 or at [JMETS@tc.columbia.edu](mailto:JMETS@tc.columbia.edu)

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## *Journal of Mathematics Education at Teachers College*

### **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](mailto: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](mailto: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
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# Irish-Medium Language Immersion Programs' Effects on Mathematics Education

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In Ireland, there are areas where the Irish language is spoken exclusively, these areas are called Gaeltacht. Students living in those areas speak Irish both at home and at school. But outside those areas, schools teach in the English language. This is changing due to Gaelscoileanna. Now students who are speaking English at home and in the neighborhood are being taught in Irish at school. Additive bilingualism occurs in students attending Gaelscoileanna since they are immersed in both languages on a daily basis. This has shown to have positive impacts on mathematics learning. Other countries, such as Wales, Scotland, and Canada, have implemented similar types of schools. Research on Irish-medium language immersion programs effects on mathematics education is presented.

*Keywords:* Irish – Mathematics Education – Language Immersion – Bilingualism

## Introduction

Mathématiques, 数学, Matemáticas, Математика, الرياضيات علم الرياضة, Mathematics, and Matamaitic. The first six are the official languages spoken at the United Nations (French, Chinese, Spanish, Russian, Arabic and English); the final translation of the word “mathematics” is written in Irish. In today’s global community, it is a common question to be asked the number of languages one speaks fluently. MacNamara (1967) defines bilinguals as those who possess at least one language skill (listening, speaking, reading, or writing) even to a minimal degree in a second language. Ireland is attempting to be competitive in this market, both for economic and cultural reasons, by promoting its Irish language through Irish-medium school language immersion programs called Gaelscoileanna (primary level) and Gaelchólaistí (secondary level). Background and research on Irish-medium schools in Ireland will be presented describing the effects these programs have on mathematics education.



Official Gaeltacht regions in Ireland  
(denoted by dark shaded areas)  
Map created by Údarás na Gaeltachta  
on [www.udaras.ie](http://www.udaras.ie)

## Background of Irish-Medium Schools

Irish Gaelic, the ancient language of the Irish, is related to Welsh and other Celtic languages. It is the language of the poems and legends of Ireland’s great early period. After England began to rule Ireland, however, the English language became the tongue of everyday life. Eventually Irish Gaelic was spoken only in remote parts of the country, known as Gaeltacht (see map of Official Gaeltacht regions in Ireland). Currently, both English and Irish Gaelic (referred to as simply Irish—to promote a national image) are official languages of Ireland. Most of the Irish people do not speak Irish well enough to use it for conversation outside of the Gaeltacht—although there is an obligatory Irish language class requirement for students throughout their entire education. “Irish ... is one of thousands of ‘endangered languages’ worldwide. Though it is Ireland’s official tongue, there are only about 30,000 fluent speakers left, down from 250,000 when the country was founded” (Lydersen, 2009). Students living in the Gaeltacht speak Irish both at home and at school. But outside those few remote areas, schools teach using the English language—except in their compulsory Irish class. This has been changing since the mid-1970s due to the Gaelscoileanna and Gaelchólaistí found primarily outside the seven Gaeltacht areas. Now students who speak English at home and in the neighborhood are taught in Irish at school. Currently, the Irish Government is trying to increase the number of Irish speakers by implementing their *20 Year Strategy for the Irish Language* published in 2009. This plan includes boosting the number of Irish language speakers to 250,000 by the year 2030 and providing aid to Gaelscoileanna, leading to more Gaelscoileanna being developed (Department of Community, Equality and Gaeltacht Affairs, 2009). The plan stresses the importance of offering all children in primary schools the opportunity to experience partial-

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immersion. Currently, the majority of teacher education programs in Ireland “do not provide a formal qualification for teaching through the Irish-medium and it is not a prerequisite for employment in Irish-medium schools” (Ní Ríordáin & O’Donoghue, 2008c, p. 45). This eventually will lead to problems of proper Irish language learning in the Irish-medium schools. In the *20 Year Strategy*, primary teachers would have additional immersion classes during their teacher preparation programs to improve their own knowledge of the language (Department of Community, Equality and Gaeltacht Affairs, 2009).

Gaelscoileanna Teo., founded in 1973, is a national, voluntary organization that supports the development of Irish-medium schools at primary and post-primary level. Their 2009 statistics report that there are 169 primary and 38 post-primary Irish-medium schools outside the Gaeltacht. These statistics indicate that Irish-medium education is growing, tripled since the early 1990s, and confirm parental desire in Ireland for Irish-medium education (Duncan, 2008). The popularity of Gaelscoileanna has worried Irish residents because of the many immigrants from other countries, such as China, Nigeria, and Poland, seeking education for their children. These foreigners would most likely choose English-language instruction for their children, thus leading to a type of “white flight” from English-language education to Irish-language instruction. In response, as of 2008, each Irish-medium school has required a minimum of 5% of their student population to be foreign-born students (Duncan, 2008). The Gaelscoil movement has been the largest and most successful of any of the European lesser-used languages immersion education programs. The movement also has been successful in setting up schools in both urban and rural areas. “There are now waiting lists to get into many all-Irish-speaking schools, just as there are at exclusive private institutes” (Battles & McConnell, 2003, para. 12). The Gaelscoil initiative promotes pride in the heritage language for their students. It has also inspired other similar language immersion projects in Europe, such as the Scottish Gaelic, Catalan, and Breton schools. This attempt to keep the Irish language thriving in Ireland is respectable; however, it requires that attention be given to how it is affecting students’ learning.

### Language Immersion

Language immersion is a method of teaching a second language, or target language, in which the target language is used for instruction in all subjects. Most of today’s immersion programs throughout the world are based on those founded in the 1960s in Canada when English-speaking parents established an experimental French immersion program. As of 2005, the United States had 317 immersion programs in elementary schools with instruction in ten languages, while 96% of the programs

were in Spanish (Potowski, 2007). In the United States, these programs are to help citizens be more competitive in a global economy and to aid a growing population of second language learners. Baker (1993) found that more than 1,000 studies have been completed on immersion programs in Canada. From these studies, it has been stated that monolingual peers perform better in mathematics at an early age; however, immersion students eventually catch up with, and in some cases, surpass their monolingual counterparts (Baker, 1993). Furthermore, students in immersion programs have higher SAT and standardized test scores (Morris, 2002). Finally, Jean Piaget, a renowned developmental psychologist, stated that when a child encounters an idea that does not fit their understanding, it creates a medium for a new way of thinking (Atherton, 2010). Learning a new language in an immersion program would coincide with Piaget’s theory.

### Research on Irish-Medium Mathematics Education

Any mathematics teacher understands the power of language in the classroom. Mathematical concepts are understood by students through oral and written communication. Students in mathematics are required to speak in both everyday language and mathematical terminology. A deeply connected relationship exists between a student’s language and mathematics education. Conflicting views about learning mathematics in a second language at all levels of education have been reported. Multiple studies (Barwell, 2003; Bournot-Trites & Tellowitz, 2002; Clarkson, 1992, 2007; Cummins, 1979; Swain, 1996; Williams, 2002) have found positive correlations and cognitive benefits from learning through the medium of a second language. While other studies (Adetula, 1990; Adler & Setati, 2000; Barton, Chan, King, Neville-Barton, & Sheddon, 2005; Galligan, 1995; Gorgorió & Planas, 2001; Secada, 1992) report that students who study using a second language underachieve in mathematics. Both sides will help further research in the partnership between mathematics education and language.

In Ireland, it has been the case that Irish-medium schools have outperformed English-medium schools in mathematics. “Researchers believe these superior results are due to what may be called ‘the bilingual advantage,’ with children who are fluent in two languages having a greater amount of mental agility” (Hayes, 2010, para. 8). Before the surge of language immersion programs in the early 1970s, it was believed that bilingualism had a negative impact on cognitive development and mathematical learning (Clarkson, 2007). But since then, research has found that bilingual mathematics students who were proficient in both languages performed better in mathematics compared to monolingual students (Dawe, 1983). In the United States, Secada (1992) has studied bilingual students with similar results.



Multiple studies on Irish-medium mathematics education have been performed by Máire Ní Ríordáin and John O’ Donoghue from the University of Limerick. Their research has used many theoretical frameworks, including the Cummins’ Threshold Hypothesis (1976). This hypothesis proposes that “there might be a threshold level of language competence that bilingual students must achieve both in order to avoid cognitive deficits and to allow the potential benefits of being bilingual to come to the fore” (Ní Ríordáin & O’Donoghue, 2008c, p. 1). Ní Ríordáin and O’Donoghue studied various groups of students: strong bilingual students, weak bilingual students, and monolingual students. The results from Ní Ríordáin and O’Donoghue’s (2007) study support the hypothesis. In the tests, bilingual students having high competencies in both Irish and English (the case for students at Gaelscoileanna) outperformed students speaking only one language. On the other hand, bilingual students with low competencies in Irish and English had inferior results compared to the other groups (Ní Ríordáin & O’Donoghue, 2008c). A study in New Zealand provided further support for the importance of strong abilities in both languages for bilingual learners to succeed in mathematics. At the secondary and college levels, it was reported that having weakness in one of the languages resulted in a 10-15% disadvantage in mathematics compared to their stronger bilingual peers (Barton et al., 2005). These studies suggest that the quality of education in both languages at language immersion programs, such as Gaelscoileanna, directly affects the students’ success in mathematics.

One area of concern, though, is when the students graduate secondary school and move on to college-level studies. The transition from Irish-medium instruction to English-medium instruction could cause some problems in understanding. A possible solution for language immersion programs, Gaelscoileanna included, is to provide some instruction in English toward the end of the secondary level to allow an easier transition into college, wherever the students plan to study. It has been shown that graduating Irish-medium students have performed better than graduating students from Gaeltacht secondary schools (Ní Ríordáin & O’Donoghue, 2008a). This brings up the point of additive bilingualism versus subtractive bilingualism. Lambert (1977) defines additive bilingualism as the student adding another socially relevant and respected language to his repertoire of skills at no cost to his first language competence. Subtractive bilingualism is defined as the second language added at the expense of the first language and culture—which eventually will weaken as a consequence (Cummins, 1994). Students attending Gaelscoileanna have been immersed in both Irish (at school) and English (at home) on a daily basis so they acquire additive bilingualism. Research has shown the positive effects additive bilingualism has on mathematics education. These benefits include better evaluation skills,

higher IQ measures, improved cognitive abilities, greater mental flexibility, and superior problem solving thinking compared to monolingual students (Bournot-Trites & Tellowitz, 2002; Swain, 1996; Turnbull, Hart, & Lapkin, 2000). Students transitioning from Gaeltacht schools (Irish is the dominant language of the school, community, and home) to English-medium colleges experience subtractive bilingualism. Research indicates the negative outcomes of subtractive bilingualism on mathematics education, such as a lack of vocabulary skills, a misunderstanding of definitions, and a lack of abstract thinking (Adetula, 1990; Hans & Ginsburg, 2001; Marsh, Hau, & Kong, 2000; Ní Ríordáin & O’Donoghue, 2008b). Thus, it is even more important that Gaeltacht students acquire some English instruction in order to develop a sufficient level of academic English and to promote the acquisition of additive bilingualism once they graduate.

### Conclusion

Ireland is to be admired for how they are attempting (and succeeding) to keep their heritage language alive, especially considering the fact that it is on the endangered language list provided by UNESCO (2010). Focusing on Ireland, since it has such a distinct separation between Irish and English, could help further the research on how to assess most effectively how bilingualism is affecting mathematics education in other parts of the world. Although each country has its own curricula, teacher preparation, and cultural background, making it difficult to generalize results from different countries, it is important to take into account how mathematics teaching is directly linked to its location. In the United States, many immigrant students are experiencing subtractive bilingualism; the goal of assimilating to American culture pushes students to leave behind their own heritage language. Teachers need to be aware of this and work on promoting a more additive bilingualism approach to education for both immigrant and native students. On the other hand, some might say some parts of the US are heading in the direction of the English-language being overrun with another language, such as Spanish. In many schools, there are signs written in both Spanish and English. It would be expected that American parents would rally to promote the English language and build schools where it would be taught exclusively, a situation similar to why the Irish-medium schools were created.

The studies from Ireland and other nations have demonstrated a connection between mathematics and language. The theories from 40 years ago that bilingualism hinders a student’s growth in mathematics education should be reconsidered. It has been shown that having high proficiency in both languages creates the best scenario in mathematics for bilingual learners. Other countries, such as Wales (Williams, 2002), Scotland (Johnstone, Harlen,

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MacNeil, Stradling, & Thorpe, 1999), and Canada, have implemented similar types of schools with similar results. Therefore, with the known positive outcomes of fluency in many languages, it is necessary for Ireland and other countries to pursue and support their language immersion programs. Has the United States fallen behind by not putting more emphasis on becoming bilingual in schools?

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