The Mathematics Educator
2007, Vol. 17, No. 2, 41–51

An Analysis of the New Elementary Mathematics Teacher Education Curriculum in Turkey

Mine Isiksal
Yusuf Koc
Safure Bulut
Tulay Atay-Turhan

The purpose of this paper is to describe and reflect on the changes in the new elementary mathematics teacher education curriculum in Turkey. It is our goal to share the revised teacher education curriculum with the outside mathematics teacher education community. The paper is organized around four major sections: An overview of the teacher education system in Turkey, the characteristics of the previous mathematics teacher education curriculum, the need for the revisions, and characteristics of the revised curriculum.

All over the world, there has been increased attention on the professional education of teachers at all levels (Bishop, Clements, Keitel, Kilpatrick, & Leung, 2003; Darling-Hammond & Bransford, 2005). Among other disciplines mathematics teacher education has been at the focus of reform in teacher education (Lin & Cooney, 2001). The curriculum for the education of mathematics teachers has also been considered a very crucial aspect of the mathematics teacher education enterprise (Grossman, Schoenfeld, & Lee, 2005). In Turkey, policy makers have recently revised the existing curriculum for the education of elementary school mathematics teachers as part of a larger scale revision of teacher education curricula (Higher Education Council [HEC], 2006). In this paper, our purpose is to describe and reflect on the changes in the new elementary mathematics teacher education curriculum in Turkey. We will discuss the history of mathematics teacher education in Turkey, the major motivations for revising the previous curriculum of elementary mathematics teacher education programs, and the development process and characteristics of the revised curriculum.

Mine Isiksal is currently doing her post-doc at State University of New York. She received her Ph.D. in mathematics education in the Department of Secondary Science and Mathematics Education at the Middle East Technical University, Turkey.

Yusuf Koc is currently a lecturer in mathematics education in the Department of Elementary Education at Middle East Technical University, Turkey. He received his Ph.D. in mathematics education from Indiana University.

Safure Bulut is currently an associate professor in the Department of Secondary Science and Mathematics Education at Middle East Technical University, Turkey. She received her Ph.D. in mathematics education from Middle East Technical University.

Tulay Atay-Turhan worked at Middle East Technical University, Turkey for the past two years. She received her Ph.D. in Early Childhood Education from Florida State University.

History of Mathematics Teacher Education in Turkey

Beginning from the foundation of the Republic of Turkey in 1923, Turkey has aimed to raise its standards in economical, social, political, and educational arenas to that of the developed countries through a wide range of reform efforts. Reforms in the field of education were among the most important changes in the 1920s (Cakiroglu & Cakiroglu, 2003). In 1924, the Turkish education system was centralized and all educational institutions were put under the control of the Ministry of National Education (MNE) (Binbasioglu, 1995). Changing the country's teacher education system was another focus of reform. Before 1980, teachers were graduating from a variety of institutions with diverse experiences (see Cakiroglu & Cakiroglu, 2003 for details); however, in 1981, all teacher education institutions were placed under the authority of the HEC for a unified system of teacher training. Later, in 1989, the Council mandated that teacher candidates be educated in four-year colleges in order to be eligible for a teaching certificate (Binbasioglu, 1995). The reform wave in Turkish teacher education was quite strong in the late 1990s. In 1998, with a support from the World Bank, the HEC restructured teacher education programs to enhance quality; this was part of

a four-year project involving changes in all primary and secondary teacher education programs in colleges of education (Bulut, 1998).

Prior to the 1998 changes, there were 26 departments or divisions of mathematics education awarding licenses for secondary mathematics teaching (grades 6 thru 11). As a result of these changes, the existing programs were closed and replaced by 28 elementary and 12 high school mathematics teacher education programs (Center for Student Selection and Placement, 1998). As part of the change, teacher education curricula, including the mathematics teacher education curriculum, were substantially revised. The 1998 curriculum was put in place starting from the fall semester of 1998; the details of the program are given in Appendix A. For additional details of the 1998 curriculum, see Bulut's 1998 article.

The previous elementary mathematics teacher education curriculum was in use for eight years, from 1998 to 2006. During this time, in various academic and public platforms, including symposiums, panels, workshops and conferences, the qualifications of the preservice teachers in the previous curriculum were questioned. There was a consensus on the inadequacy of the subject matter knowledge, pedagogical content knowledge, and skills of the preservice teachers in the face of current societal and technological demands. It was concluded that the teacher education curriculum was partly responsible for such problems in the education of mathematics teachers. In order to find solutions to existing problems, the HEC collaborated with the faculty and deans of the colleges of education and decided to revise the existing curriculum. In this article, as a continuation of Bulut's (1998) discussions, the characteristics of the 2006 elementary mathematics teacher education curriculum are discussed and compared with the 1998 curriculum.

Currently, in Turkey, elementary mathematics teachers are certified to teach 4^{th} through 8^{th} grade mathematics; yet, they mainly teach sixth, seventh and eighth grades. High school graduates are admitted to teacher education programs via the university entrance exam. Some high schools focus on careers in education; they follow the national high school curricula but offer professional education courses, e.g., introduction to education and educational psychology. Because graduates of these high schools are given extra points on the university entrance exams, most of the teacher education majors have graduated from such high schools.

Preservice teachers take courses in three major areas: content courses, general education courses, and pedagogy courses (Appendixes A & B). Mathematics courses, science courses, and mathematics teaching methods courses constitute the content area courses. General education courses, referred to in the United States as a core curriculum, provide preservice teachers with necessary background in technology, social, cultural and historical topics such as computer literacy, foreign language, and Turkish History and Language. Preservice elementary mathematics teachers are also required to take a number of pedagogy courses. These are mainly devoted to topics in general pedagogy, including educational psychology, classroom management and counseling. Preservice elementary mathematics teachers also engage in field experiences and student teaching activities as part of their education. These students take 146 credit hours of courses to graduate from the program.

It is always hard to characterize an entire education system, but we will try to portray what happens in these three categories of courses. Mathematics and physics are usually taught in a very traditional way, through lecture. There are generally two midterms and one final examination to assess student performance in such courses. The mathematics teaching methods courses are expected be taught in a non-traditional format where theory and practice are blended to help the preservice teachers understand applications of theories and earn first-hand experience through various activities. General education courses are taught by faculty with diverse backgrounds; as a result, while some of them prefer lecturing, others promote more student participation. In addition to regular paper-pencil tests, projects are used to assess student performance in those courses. The pedagogy courses are taught in various ways. While lecture is common, student presentations, video presentations, small group work, whole group discussions and other non-traditional methods are used to deliver pedagogy courses.

The entire teacher education program takes four years, equivalent to a regular undergraduate degree. The two academic semesters, fall and spring, each last about 14 weeks. Teaching certificates awarded by universities are permanent and valid throughout the country. Certified teachers are required to pass the Government Staff Selection Exam (KPSS) in order to work in public schools. Only 2% of all elementary schools (757 schools out of 34,656) are operated by private organizations. They recruit teachers based on their own criteria.

Motivations for the Revision of the Teacher Education Curriculum

We will discuss four major motivations for the revision of the teacher education curriculum. These are (a) preparation for integrating with the European Union, (b) the changes in the elementary school mathematics curriculum, (c) the need for better qualified teachers, and (d) problems with the previous curriculum (HEC, 2006).

Integration With the European Union

Turkey, in general, could benefit in many ways from European Union (EU) membership. In particular, we expect to become more integrated, more prosperous, more autonomous, and more democratic as an EU member. In addition to reorganizations in political, economical and social areas, education is considered a critical component of the integration process with the EU. Turkey's long-standing wish to be a member of the EU motivated teacher educators and curriculum developers to revise teacher education programs and improve the level of teaching standards (HEC, 2006). This reform is not limited to the K-12 curriculum.

Changes in the Elementary School Mathematics Curriculum

In 2003, the Turkish Ministry of National Education organized a curriculum development team to revise the existing elementary school mathematics curriculum. The new curriculum was designed as part of a larger-scale curriculum reform initiative that included five content areas: mathematics, science, social sciences, life science and Turkish language (Koc, Isiksal, & Bulut, 2007). One of the major objectives of this curriculum reform was to promote teaching and learning environments in which students can share their ideas and actively participate (MNE, 2006). The new curriculum placed a heavy emphasis on children's cognitive development, emotions, attitudes, interests, self-confidence, beliefs, anxiety, self-regulation, psychomotor development and social skills. Additionally, the curriculum promoted student discussion, inquiry, and curiosity about what is going on in their families, schools, and society (MNE, 2004). Researchers suggest replacing rote memorization with learning for understanding (Hiebert, Carpenter, Franke, et al., 1997). In order to address this and to increase student participation, teachers were encouraged to set up student-centered classroom environments. Furthermore, it was within the goals of the curriculum to encourage students to work collaboratively, to communicate effectively about their ideas and to reflect on their learning. Research suggests that this will give students a chance to express their ideas and increase self-confidence (Bandura, 1986).

Problem solving, a critical aspect of understanding (Polya, 1957), was introduced as an integral aspect of all subject areas in the new curriculum. For meaningful student learning, the curriculum encouraged teachers to consider the outside contextual elements, such as lifestyle and geographical factors, while designing classroom tasks. Finally, assessment was regarded as an essential part of the classroom instruction (Irish National Council for Curriculum and Assessment, 1999; United Kingdom Qualifications and Curriculum Authority, 1999; National Council of Teachers of Mathematics [NCTM], 1995, 2000; Romberg, 2004).

Expected teacher dispositions in the new school curriculum. Teachers are expected to exhibit a variety of skills and characteristics in order to effectively implement the new elementary school curriculum. First of all, they should believe that all students can learn mathematics. This particular characteristic is essential in promoting equity in mathematics learning. Aligned with this, teachers are to respect and follow all aspects of human rights and ethical values in mathematics classrooms. Teachers are also expected to work toward helping students develop positive attitudes about mathematics. Additionally, teachers need to guide and motivate students in learning mathematics. They should also motivate students to ask questions, engage in critical thinking, state and support ideas, and inquire about the subject matter. To accomplish these goals, teachers must know their students, parents, and the community in which they live. Additionally, it is explicitly stated in the new curriculum that mathematics teachers should enjoy teaching mathematics.

Teaching responsibilities of elementary school mathematics teachers. In elementary schools, mathematics teachers are required to teach 15 class hours per week. They are paid for every extra hour above 15 hours. Additionally, in some schools, mathematics teachers are assigned a class of advisees. Like all other teachers, mathematics teachers are also responsible for organizing and leading social activities such as sporting events, national ceremonies, and extracurricular activities. There are at least two department meetings and two general faculty meetings in elementary schools. Additionally, some teachers organize after school and weekend courses for students willing to receive extra mathematics instruction for a minimal fee.

The curriculum states that teachers should develop and implement instructional activities that promote mathematical understanding, regularly monitor and evaluate student learning, effectively manage instructional time, and encourage students to evaluate their own and their peers' progress. Teachers are also expected to use assessment and evaluation results to improve the quality of instruction. Furthermore, mathematics teachers should collaborate with parents, other school personnel, and the outside community to improve the quality of schooling. Given the above expectations for the teachers, it is definitely important that teachers develop self-confidence and self-regulation skills. Finally, they need to continuously improve their professional knowledge and experiences through a variety of activities, including following scientific research literature and conducting small-scale research projects.

The Need for Better-Qualified Teachers

One of the key factors in improving instruction and student understanding in the mathematics classroom is the role of the teacher (Hiebert et al., 1997). The above discussions indicate that there is a need for qualified teachers to be able to implement the new elementary mathematics school curriculum effectively. Teaching mathematics effectively is a complex endeavor, and there are no easy recipes for success. Effective teachers must know and understand the mathematics they are teaching, and they must flexibly draw on that knowledge (Hill, Schilling, & Ball, 2004). While challenging and supporting students, teachers need to understand the gap between what their students know and what they need to learn (NCTM, 2000). NCTM (1991) emphasizes that "teachers must help every student develop conceptual and procedural understandings of numbers, operations, geometry, measurement, statistics, probability, functions, and algebra and the connections among ideas" (p. 21). Thus, in order to develop the conceptual and procedural understanding of students, teachers should understand the content on both of these levels.

Mathematics teachers not only need to have sufficient content knowledge of mathematics, but also pedagogical content knowledge (Even, 1990). Teachers need to know why mathematical statements are true, how to represent mathematical ideas in multiple ways, what constitutes an appropriate definition of a term or concept, and methods for appraising and evaluating mathematical methods, representations, or solutions (Hill, Schilling, & Ball, 2004). Subject matter knowledge and pedagogical content knowledge are essential in effective mathematics teaching and in the preparation of mathematics teachers (NCTM, 2000).

Tirosh (2000) states that a major goal in teacher education programs should be to contribute to the development of preservice teachers' knowledge of common ways children think about school mathematics topics. She conjectures that the experience acquired in the course of teaching is the main, but not the only, source of teachers' knowledge of students' common conceptions and misconceptions. Preservice teachers' own experiences as learners, together with their familiarity with relevant developmental and cognitive research, could be used in teacher education programs to enhance their knowledge of common ways of thinking among children. In summary, mathematics content and pedagogical content knowledge are critical factors in the effectiveness of mathematics teachers.

The new school curriculum requires teachers to expand their theoretical knowledge and student-centered teaching experiences. These needs motivated the Turkish Higher Education Council to revise the teacher education programs. The HEC aimed to increase the quantity and quality of the courses in the teacher education curriculum to help preservice teachers increase their professional knowledge and skills to teach elementary school mathematics. In Turkey, teacher education programs experience a number of challenges in achieving these goals, including a limited number of faculty members specialized in teacher education, inadequate university-school partnerships, lack of enough field and student teaching experiences, and issues with the quantity and quality of the teaching methods courses.

Problems With the Previous Curriculum

The developers of the new teacher education curriculum identified major handicaps of the content and implementation of the curriculum that had been in place during the previous eight years. Teacher education programs experienced a number of challenges in achieving these goals, including a limited number of faculty members specialized in teacher education, inadequate university-school partnerships, lack of enough field and student teaching experiences, and issues with the quantity and quality of the teaching methods courses.

Here, we mention the major problems and how they were overcome in the revised curriculum. These problems fit into two main categories: (a) content and pedagogy and (b) policy.

In the previous curriculum, there were 27 content and pedagogy courses, including mathematics, science and teaching methods courses (Appendix A). Among these 27 courses, only 13 of them were mathematics courses. Preservice elementary mathematics teachers were also required to take 9 content courses outside their major area, such as biology, physics, and chemistry, in order to build interdisciplinary connections between science and mathematics. These students were also expected to reach the same level of proficiency in science as that required of science teachers. In fact, preservice elementary mathematics teachers were required to obtain a supplementary teaching certificate in elementary science. Interestingly, they were only required to complete 13 courses in their major area, mathematics. This imbalance between the number of science and mathematics courses became one of the major concerns of teacher educators and other specialists as they revised the teacher education curriculum.

Another concern regarding the content of the teacher education curriculum was the limited number of general education courses. In the previous program of study, there were ten courses designed for general education of the preservice teachers, including history, Turkish language, foreign language, and the principles of Kemal Ataturk, the founder of the republic (Appendix A). Such courses aimed to increase teacher candidates' awareness of social, cultural, and historical issues (HEC, 2006). However, there was no specific course designed for the preservice teachers to develop awareness of social, cultural, and historical issues in their local communities, which could be accomplished through community services and university-community partnerships. Also missing were opportunities for the preservice teachers to learn more about the history of Turkish education and the cultural and philosophical roots of mathematics teaching. Thus, during the curriculum revision process, teacher educators and specialists agreed on increasing the number of general education courses to fill these needs. In the old teacher education curriculum, there were two teaching methods courses (Appendix A). The first one was devoted to general teaching methodologies and philosophies, in which the preservice teachers were involved in more theoretical aspects of pedagogy. In the second course, the students were exposed to more specific and practical applications of the teaching methodologies in mathematics teaching. They were provided experiences in constructing relationships among mathematical concepts, representations, and processes. Thus, at the end of these courses, preservice teachers should have had appropriate experiences aimed at improving their understanding of the content and pedagogy of mathematics. However, two courses devoted to the content and pedagogy of elementary school mathematics were not sufficient for addressing all elementary school mathematics concepts. Thus, a suggestion was made to increase the number of mathematics teaching methods courses for preservice teachers.

Another issue concerning teacher preparation was the limited emphasis on instructional planning and assessment. Previously, there was only one course covering both planning and assessment; however, addressing all objectives of the course in one semester was difficult. For example, instructors could not spend enough time on developing classroom tests.

Finally, preservice teachers were not provided enough experience in working with students from diverse populations, including students with special needs. Related with this issue, teacher education courses were not designed to help preservice teachers teach the subject matter for all students.

There were also issues related to the policy of double licensure. As previously mentioned, preservice elementary mathematics teachers were also certified to teach science in elementary school. Officials from the teacher education department of the Ministry of National Education decided that, due to the adequate supply of elementary school science teachers and the need for elementary mathematics teachers, the double licensure system should be rethought during the revision process.

Development Process of the New Curriculum

At the beginning of the reform process, the HEC asked some of the colleges of education to review the 1998 program, identify weaknesses and strengths of the program, and give suggestions for improvement. Then, a program revision group was formed with 25 faculty members from various teacher education programs. This group met for a week in March 2006 to form the blueprint of the revised curriculum. The blueprint was distributed to colleges of education around the country for feedback. Based on the received feedback, the final version of the curriculum was approved by the Higher Education Council in July 2006.

What's "New" in the New Mathematics Teacher Education Curriculum?

The new mathematics teacher education curriculum changes are detailed in Appendixes B and

C. First of all, as seen in Table 1, the number and percentages of courses in the content area, pedagogy courses, and general education courses are different.

Table 1

Number and Percentages of the Course Types in the Previous and Current Curricula

Type of courses	Number and percentages of the courses in the previous curriculum	Number and percentages of the courses in the current curriculum
Content & Content Teaching Methods (C)	27 (56%)	22 (44%)
Pedagogy (P)	11 (23%)	13 (26%)
General Education (GE)	10 (21%)	15 (30%)
Total	48 (100%)	50 (100%)

As indicated in Table 1, the total number of courses in the elementary mathematics teacher education curriculum increased from 48 to 50. In particular, while the percentages of content and content teaching methods courses decreased (from 56% to 44%), the percentages of pedagogy courses and general education courses increased (P: from 23% to 26%; GE: from 21% to 30%). In sum, the number of mathematics, mathematics teaching methods, general education and pedagogy courses increased; whereas, the number of science and science teaching methods courses decreased from nine to two in the revised curriculum (see Appendixes). For instance, the 13 mathematics (C) courses in the previous curriculum increased to 16 in the revised curriculum. Also, the number of general education (GE) courses increased from 10 to 15, and the number of pedagogy (P) courses increased from 11 to 13. In addition, the dual licensure requirement was removed from the teacher education programs due the ineffectiveness of the process.

One of the significant changes in the new curriculum is the emphasis given to the general education courses. Curriculum developers expected future mathematics teachers to learn more about the Turkish culture, history of the Turkish educational system, philosophy of science, and history and philosophy of mathematics. Teachers with sufficient background and skills in general studies and information technologies, sufficient experiences in performing research, and a multidimensional perspective may be more effective in their classroom practices. Yet, these history and philosophy courses are only recommended, not required, for the teacher education programs because there are not enough faculty members to teach the courses in some universities.

A new teaching profession course, Community Service Practice, helps teacher candidates become more aware of current social problems and develops university-community partnerships. As mentioned earlier, preservice teachers were not given enough opportunities to work on community-related projects in the previous curriculum. In this particular course, they are expected to work with governmental and non-governmental organizations to engage in a wide range of projects, e.g., helping people in poverty, assisting local libraries, and working with students in rural areas. The goal of this course is to motivate preservice teachers to participate in volunteer opportunities and increase their sense of empathy and awareness to social issues. They will be encouraged to participate in professional activities, such as panels, conferences, symposiums and workshops throughout the Community Service Practice course.

The new teacher education curriculum requires completion of a research methods course. The research course will provide learning opportunities for the preservice teachers to improve their research skills and practices. In particular, the course will be the main vehicle for promoting teachers' studying of their own teaching via scientific research methods, as in action research. This idea comes from Harrison, Dunn, and Coombe (2006) who argue that classroom research will be more effective if classroom teachers, active practitioners of teaching, are involved in conducting the research.

Another addition to the elementary mathematics teacher education curriculum is the Turkish Educational System and School Management course in which preservice teachers will learn about the structure and philosophy of the Turkish educational system. Also, students will have a chance to see how the school administration contributes to quality instruction.

The HEC developed the blueprint of the curriculum for the teacher education programs, but the schools of educations have flexibility in utilizing the curriculum. That is, they can remove, add, and revise the name and content of up to 30% of the total courses; however, they are not allowed to remove any pedagogy (P) courses (HEC, 2006). This flexibility will give the colleges of education a chance to organize their own teacher education programs based on their needs and capabilities.

Discussions and Recommendations

Reform efforts in the Turkish education system focused on increasing the quality of education from kindergarten to university in all content areas (Binbasioglu, 1995). The change in the elementary mathematics teacher education curriculum is part of this larger scale reform agenda.

There were four major factors that motivated policy makers, teacher educators and other specialists to revise the previous elementary mathematics teacher education curriculum: integration with the European Union, changes in the elementary school mathematics curriculum, the need for more qualified teachers, and dissatisfaction with the previous curriculum. Turkey's goal of becoming a permanent member of the European Union (EU) catalyzed their efforts to meet European Union countries' educational standards. It is believed that with the successful implementation of the new elementary school curriculum and the teacher education programs, Turkey will reach the educational levels of other European Union countries.

To implement the new elementary school curriculum, teachers need to be equipped with appropriate knowledge, skills, and experiences. The new teacher education curriculum places a considerable degree of emphasis on a successful utilization of the elementary school curriculum. This includes motivating students to ask questions, engaging students in critical thinking, and using mathematical inquiry in their mathematics classroom practices.

The new teacher education curriculum is also concerned with overcoming problems in the previous curriculum. These problems were based on content, pedagogy and policy-related issues. In the new mathematics teacher education curriculum, the number of mathematics and mathematics teaching methods, general education, and pedagogy courses increased in order to provide preservice elementary mathematics teachers with previously lacking learning opportunities. Additionally, with the increased number of mathematics teaching methods courses, the preservice teachers are expected to have a more in-depth understanding of mathematical relationships and procedures and pedagogical content knowledge. Furthermore, the introduction of more general education courses will provide preservice teachers with more experiences to increase their awareness of social, cultural, and historical issues.

The new teacher education curriculum has been implemented nationwide since Fall 2006. The transition from the previous curriculum to the new one has been challenging for the programs because the students in the same cohort do not progress at the same pace; although most of the students are able to follow their program successfully, there are others who repeat courses or fall behind their peers.

Curriculum developers aimed to increase the quality of mathematics teacher education to that of the international standards; however, revising the curriculum is not sufficient to reach the desired level. Implementation of the new curriculum program will be monitored and continuously evaluated in order to enhance the quality of teachers to the highest level. The implementation of the curriculum will be monitored by the Turkish Higher Education Council through continuous feedback from teacher educators, preservice teachers and K-12 institutions. Further monitoring attempts may be carried out by individual teacher education programs to explore the strengths and weaknesses of the revised curriculum.

References

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive*. Englewood Cliffs, NJ: Prentice Hall.

Binbasioglu, C. (1995). *Türkiyé de Eğitim Bilimleri Tarihi* [History of Educational Sciences in Turkey]. Ankara, Turkey: Ministry of National Education.

Bishop, A. J., Clements, M. A., Keitel, C., Kilpatrick, J., & Leung, F. K. S. (2003). *Second international handbook of mathematics education*. Dordrecht, Netherlands: Kluwer Academic Publishers.

Bulut, S. (1998). Changes in mathematics teacher education programs in Turkey. *The Mathematics Educator, 9*(2), 30–33.

Cakiroglu, E., & Cakiroglu, J. (2003). Reflections on teacher education in Turkey. *European Journal of Teacher Education, 26,* 253–264.

Center for Student Selection and Placement. (1998). *Öğrenci seçme ve yerleştirme sınavı ikinci basamak kılavuzu* [Student selection and placement examination manual for the second level]. Ankara, Turkey: Author.

Darling-Hammond, L., & Bransford, J. (2005). *Preparing teachers for a changing world: What teachers should learn and be able to do*. San Francisco: Jossey-Bass.

Even, R. (1990). Subject-matter knowledge for teaching and the case of functions. *International Journal of Mathematics Education in Science and Technology, 14*, 293–305.

Grossman, P. L., Schoenfeld, A., & Lee, C. D. (2005). Teaching subject matter. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 201–231). San Francisco: Jossey Bass.

Harrison, L. J., Dunn, M., & Coombe, M. (2006). Making research relevant in preservice early childhood teacher education. *Journal of Early Childhood Teacher Education, 27*, 217–229.

Higher Education Council. (2006*). Yeni Programlar Hakkında Açıklama* [Description of the new teacher education curricula]. Retrieved December 22, 2006, from http://www.yok.gov.tr/egitim/ogretmen/aciklama_program.doc

Hiebert, J., Carpenter, T. P., Fennema, E., Fuson, K. C., Wearne, D., Murray, H., Olivier, A., & Human, P. (1997). *Making sense: Teaching and learning mathematics with understanding*. Portsmouth, NH: Heinemann.

Hill, H. C., Schilling, S. G., & Ball, D. L. (2004). Developing measures of teachers' mathematics knowledge for teaching. *The Elementary School Journal, 105*(1), 11–30.

Irish National Council for Curriculum and Assessment. (1999). *Primary school mathematics* curriculum. Dublin, Ireland: Author.

Johnson, D. W., & Johnson, R. (1990). Cooperative learning and achievement. In S. Sharan (Ed.), *Cooperative learning: Theory and research* (pp. 23–37). New York: Praeger.

Koc, Y., Isiksal, M., & Bulut, S. (2007). The new elementary school curriculum in Turkey. *International Education Journal, 8*(1), 30–39.

Lin, F. L., & Cooney, T. J. (2001). *Making sense of mathematics teacher education*. Dordrecht, Netherlands: Kluwer Academic Publishers.

Ministry of National Education. (2004). *Müfredat geliştirme süreci: Program geliştirme modeli çerçevesinde yapılan çalışmalar* [Curriculum development process: Activities conducted around the curriculum development model]. Ankara, Turkey: Author.

Ministry of National Education. (2005). *PISA 2003 Projesi ulusal nihai raporu* [Final national report of PISA 2003]. Ankara, Turkey: Egitim Arastirmalari ve Gelistirme Dairesi.

Ministry of National Education. (2006). *İlköğretim matematik dersi (1-5 sınıflar) öğretim programı* [Elementary school mathematics curriculum (grades 1-5)]. Ankara, Turkey: Author.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (1995). *Assessment standards for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

Polya, G. (1957). *How to solve it* (2nd ed.). Princeton, NJ: Princeton University Press.

Romberg, T. A. (2004). *Standards-based mathematics assessment in middle school: Rethinking classroom practice*. New York: Teachers College Press.

Tirosh, D. (2000). Enhancing prospective teacher' knowledge of children's conceptions: The case of division of fractions. *Journal for Research in Mathematics Education, 31*, 5–25.

United Kingdom Qualifications and Curriculum Authority. (1999). *The national curriculum*. London: Author.